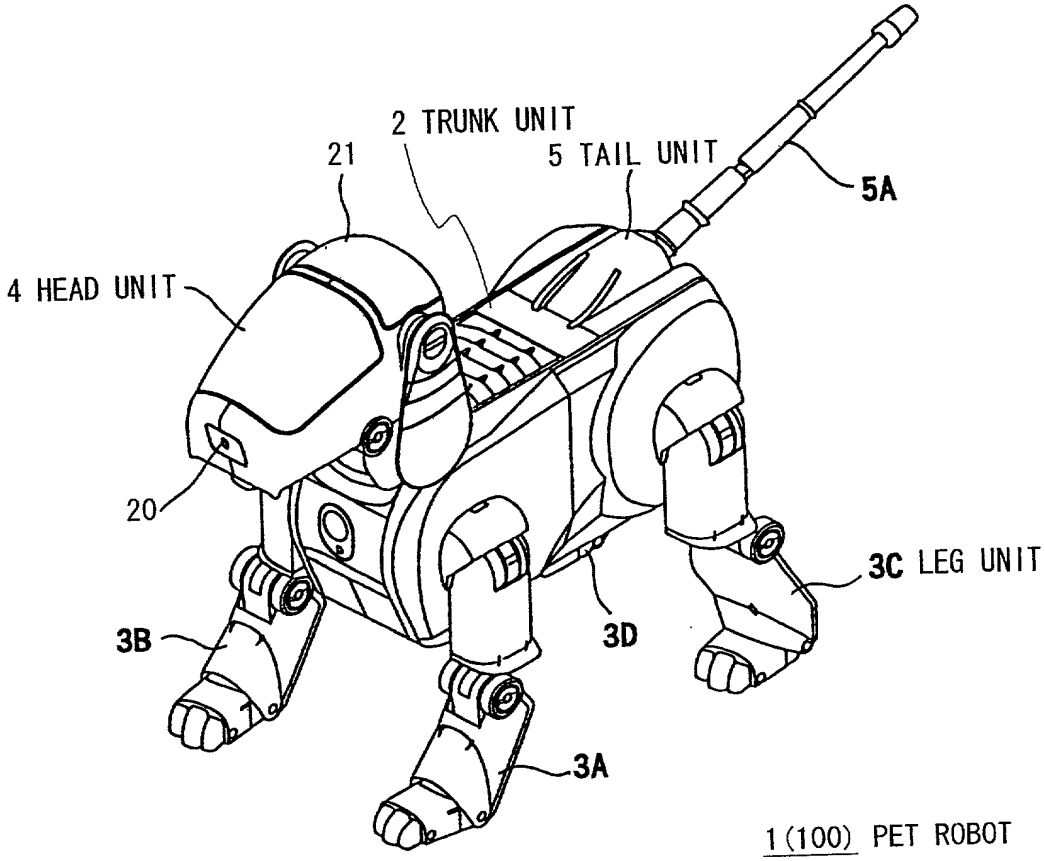

2 TRUNK UNIT
21
5 TAIL UNIT
5A
4 HEAD UNIT
20
3C LEG UNIT
3B
3D
3A
1(100) PET ROBOT

FIG. 1

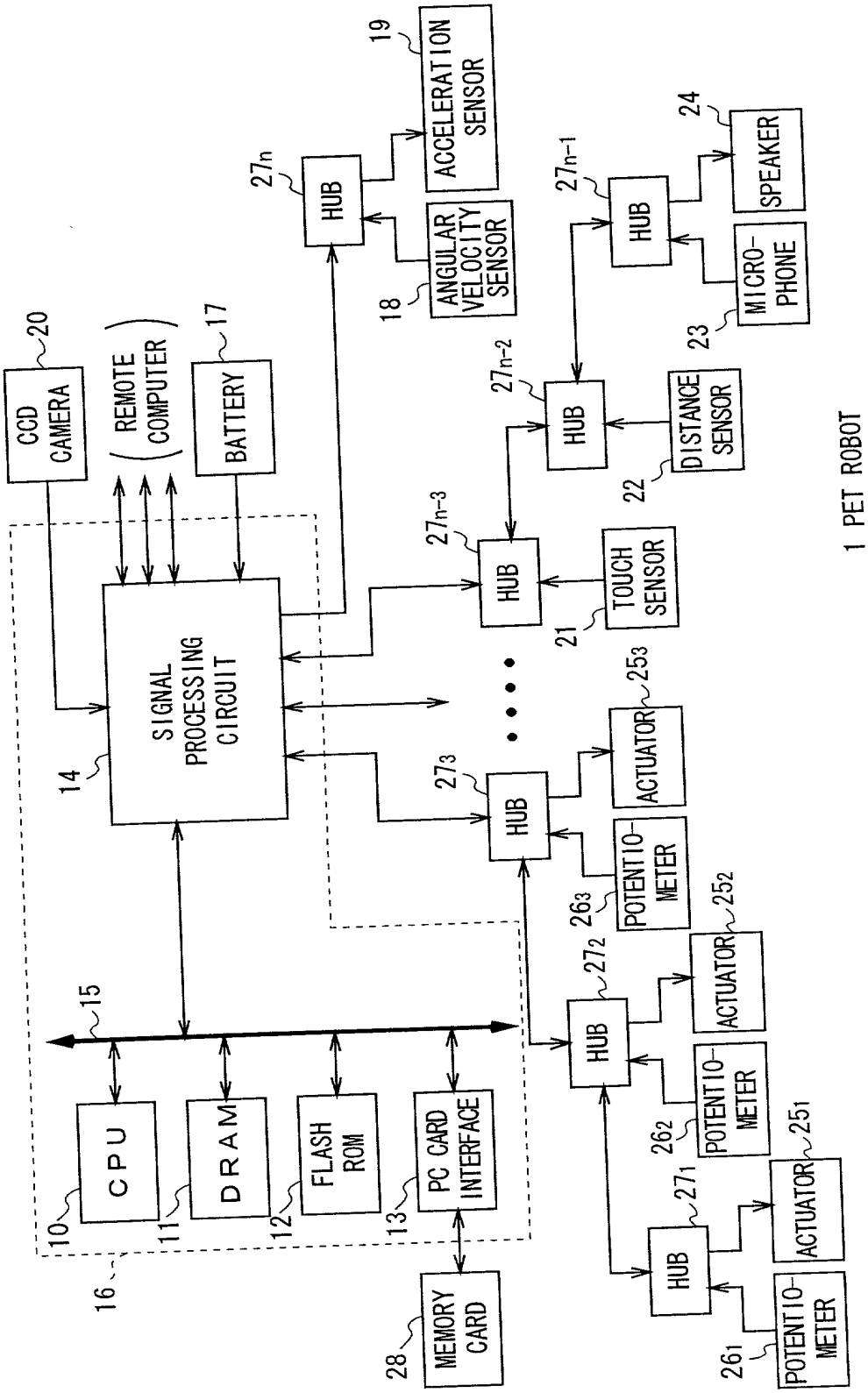

1 PET ROBOT
CCD CAMERA
REMOTE COMPUTER
BATTERY
SIGNAL PROCESSING CIRCUIT
CPU
DRAM
FLASH ROM
PC CARD INTERFACE
MEMORY CARD
HUB
ACCELERATION SENSOR
ANGULAR VELOCITY SENSOR
SPEAKER
MICRO-PHONE
DISTANCE SENSOR
TOUCH SENSOR
ACTUATOR
POTENTIO-METER

FIG. 2

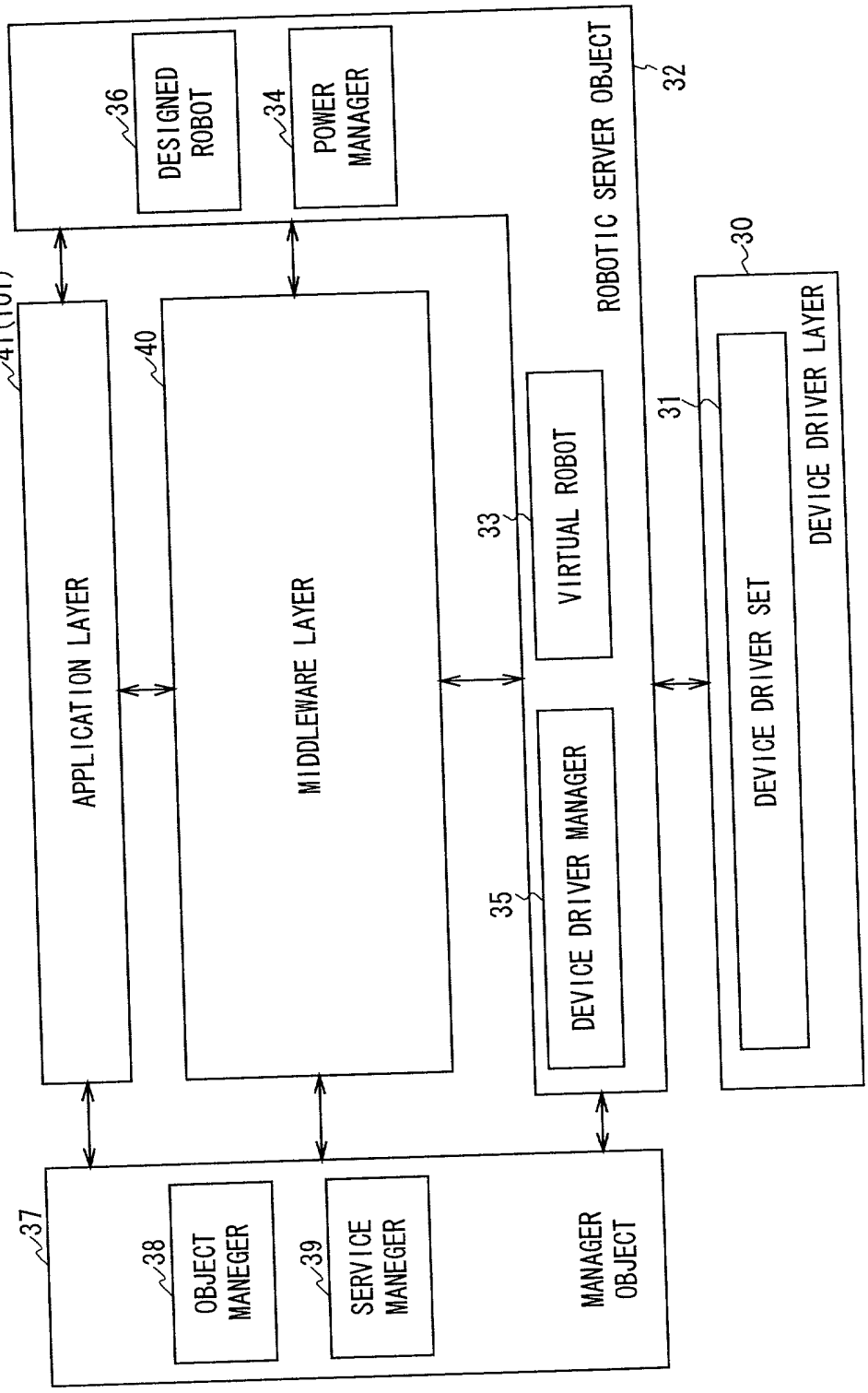

ROBOTIC SERVER OBJECT
32
DESIGNED ROBOT
36
POWER MANAGER
34
41(101)
APPLICATION LAYER
40
MIDDLEWARE LAYER
33
VIRTUAL ROBOT
31
30
DEVICE DRIVER LAYER
DEVICE DRIVER SET
35
DEVICE DRIVER MANAGER
37
MANAGER OBJECT
38
OBJECT MANEGER
39
SERVICE MANEGER

FIG. 3

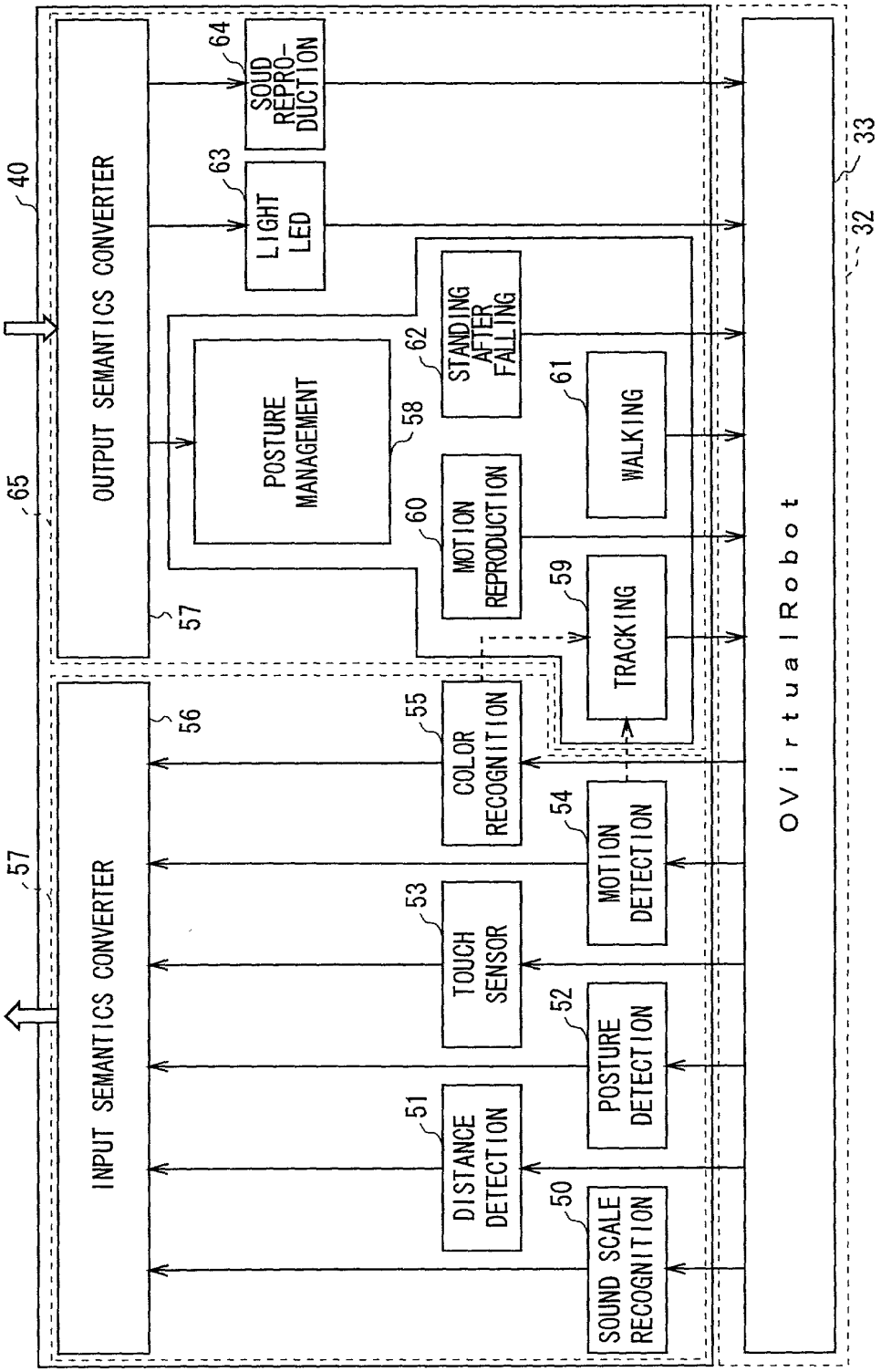

INPUT SEMANTICS CONVERTER
57
OUTPUT SEMANTICS CONVERTER
40
65
56
57
SOUND SCALE RECOGNITION
50
DISTANCE DETECTION
51
POSTURE DETECTION
52
TOUCH SENSOR
53
MOTION DETECTION
54
COLOR RECOGNITION
55
TRACKING
59
MOTION REPRODUCTION
60
POSTURE MANAGEMENT
58
WALKING
61
STANDING AFTER FALLING
62
LIGHT LED
63
SOUD REPRO-DUCTION
64
OVirtualRobot
32
33

FIG. 4

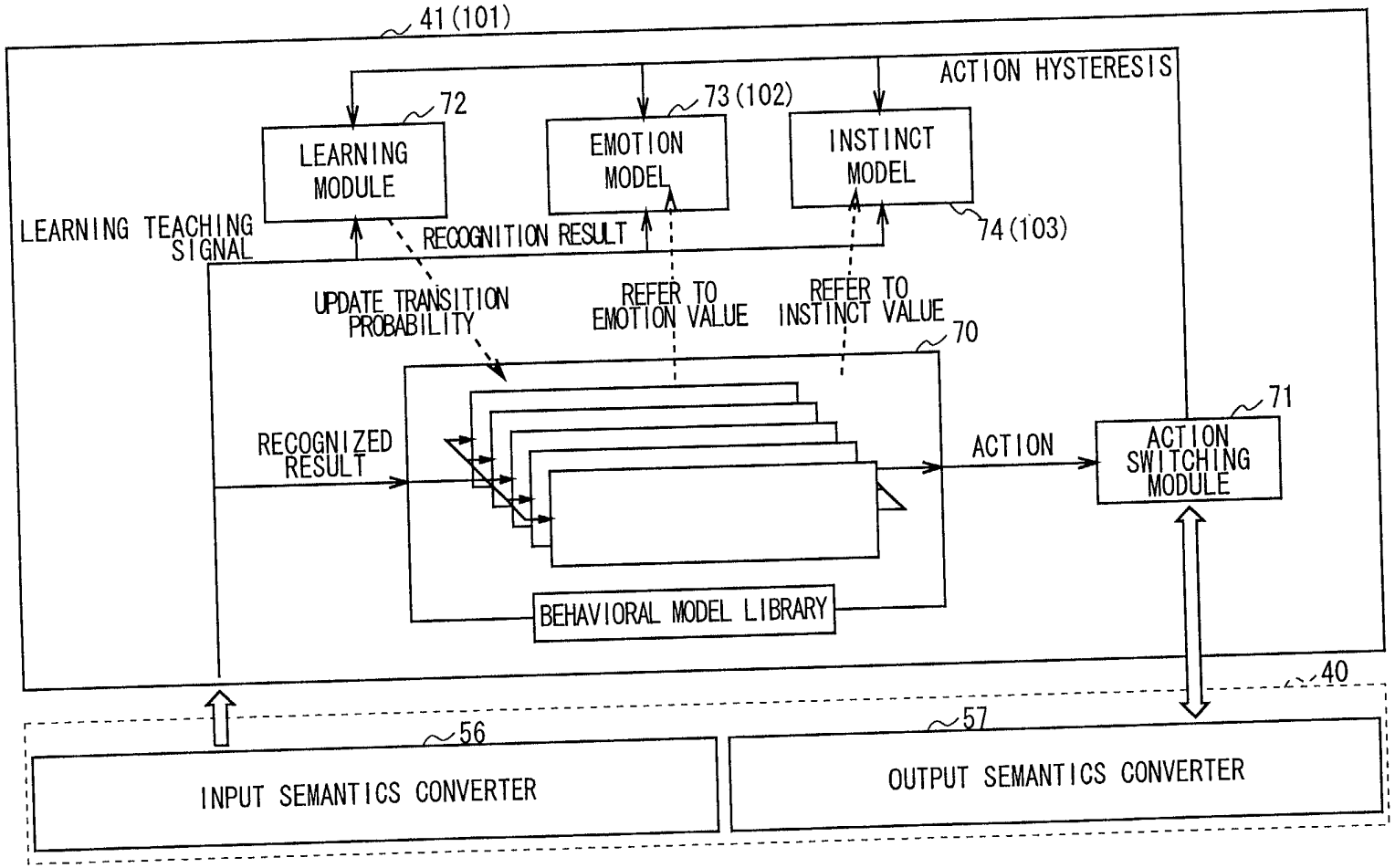


FIG. 5

09/890231

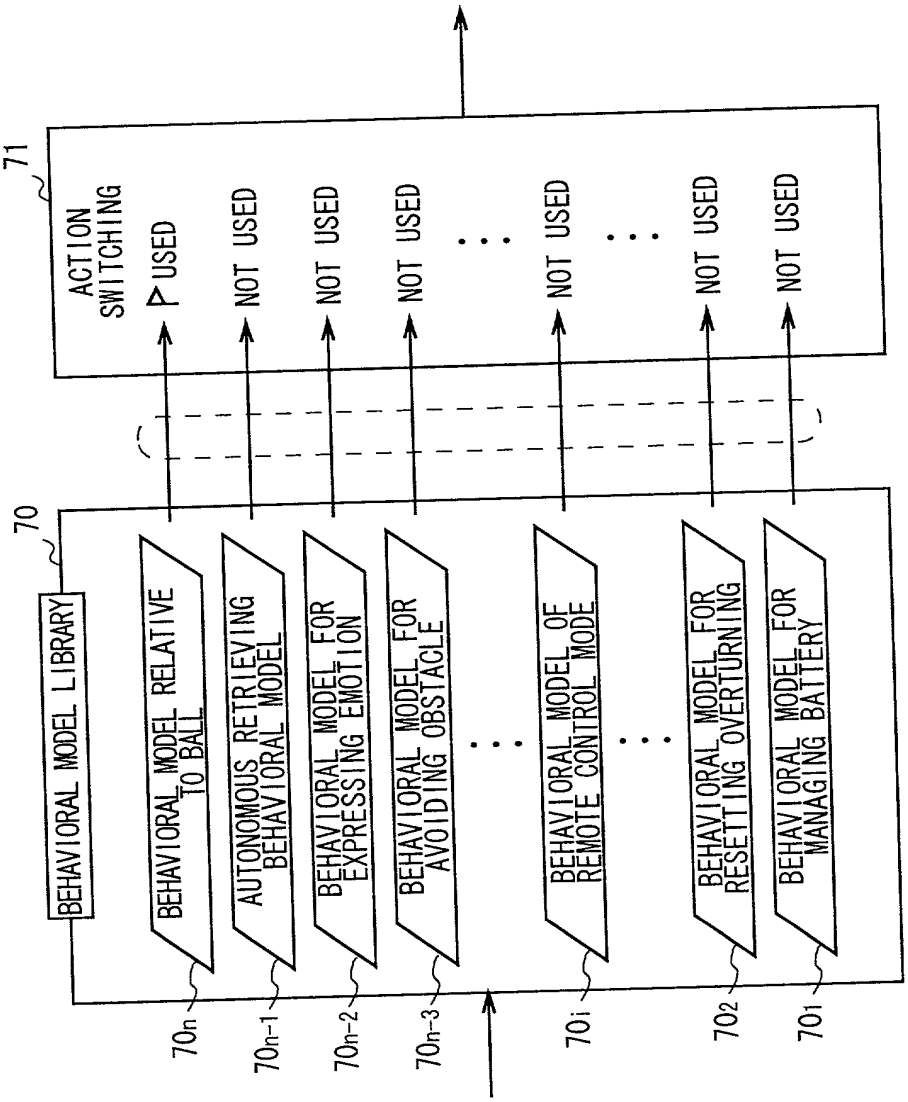

71
ACTION SWITCHING
USED
NOT USED
NOT USED
NOT USED
NOT USED
NOT USED
NOT USED
70
BEHAVIORAL MODEL LIBRARY
BEHAVIORAL MODEL RELATIVE TO BALL
AUTONOMOUS RETRIEVING BEHAVIORAL MODEL
BEHAVIORAL MODEL FOR EXPRESSING EMOTION
BEHAVIORAL MODEL FOR AVOIDING OBSTACLE
BEHAVIORAL MODEL OF REMOTE CONTROL MODE
BEHAVIORAL MODEL FOR RESETTING OVERTURNING
BEHAVIORAL MODEL FOR MANAGING BATTERY
70n
70n-1
70n-2
70n-3
70i
702
701

FIG. 6

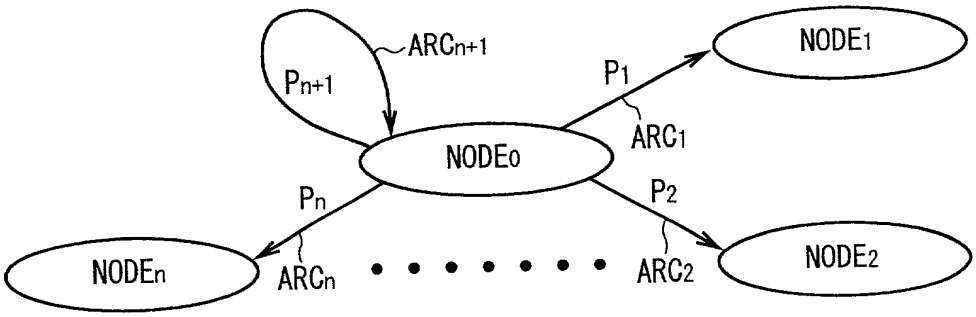

ARCn+1
Pn+1
NODE1
P1
ARC1
NODE0
Pn
P2
NODEn
ARCn
ARC2
NODE2

FIG. 7

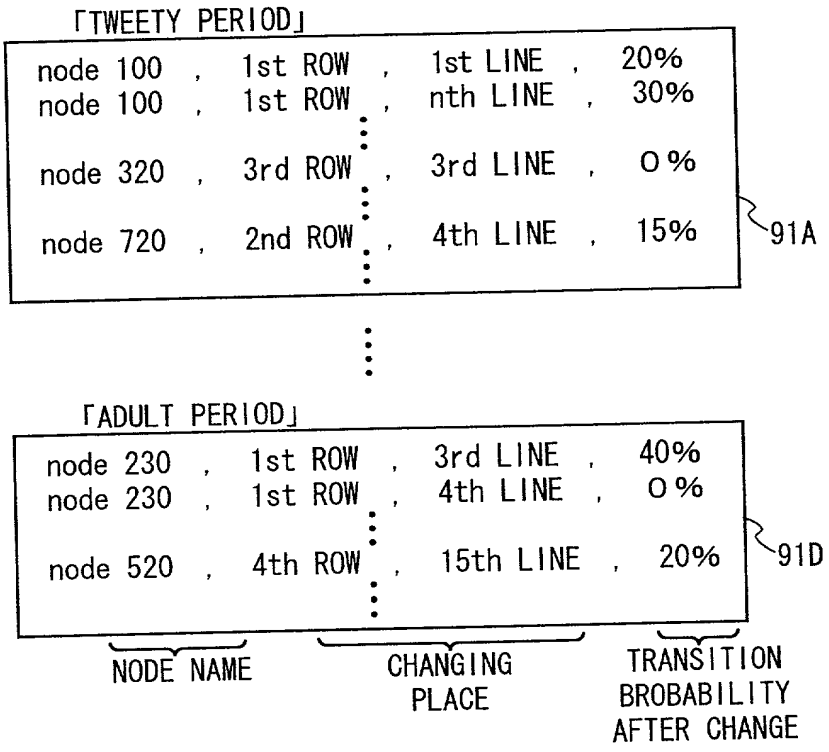

「TWEETY PERIOD」
node 100 , 1st ROW , 1st LINE , 20%
node 100 , 1st ROW , nth LINE , 30%
node 320 , 3rd ROW , 3rd LINE , 0%
node 720 , 2nd ROW , 4th LINE , 15%
91A
「ADULT PERIOD」
node 230 , 1st ROW , 3rd LINE , 40%
node 230 , 1st ROW , 4th LINE , 0%
node 520 , 4th ROW , 15th LINE , 20%
91D
NODE NAME
CHANGING PLACE
TRANSITION BROBABILITY AFTER CHANGE

FIG. 12

T02270 "TE206860

	INPUT EVENT NAME	DATA NAME	RANGE OF DATA	TRANSITION PROBABILITY TO ANOTHER NODE				
	node 100			A	B	C	D	n
TRANSITION TARGET NODE				node 120	node120	node 1000		node 600
OUTPUT ACTION				ACTION 1	ACTION 2	MOVE BACK		ACTION 4
1	BALL	SIZE	0, 1000	30%				
2	PAT				40%			
3	HIT				20%			
4	MOTION					50%		
5	OBSTACLE	DISTANCE	0, 100			100%		
6		JOY	50, 100					
7		SUPRISE	50, 100					
8		SADNESS	50, 100					

80

FIG. 8

09/890231

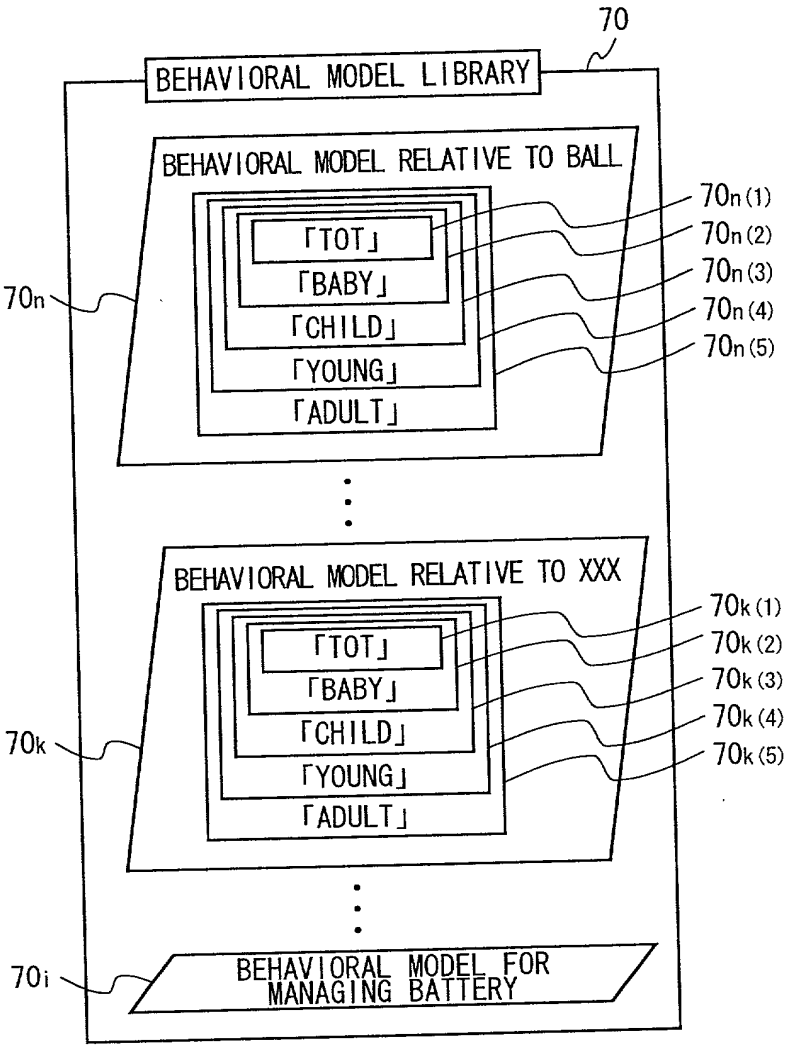

70
BEHAVIORAL MODEL LIBRARY
BEHAVIORAL MODEL RELATIVE TO BALL
「TOT」
「BABY」
「CHILD」
「YOUNG」
「ADULT」
70n
70n(1)
70n(2)
70n(3)
70n(4)
70n(5)
BEHAVIORAL MODEL RELATIVE TO XXX
「TOT」
「BABY」
「CHILD」
「YOUNG」
「ADULT」
70k
70k(1)
70k(2)
70k(3)
70k(4)
70k(5)
70i
BEHAVIORAL MODEL FOR MANAGING BATTERY

FIG. 9

T02220 TE206860

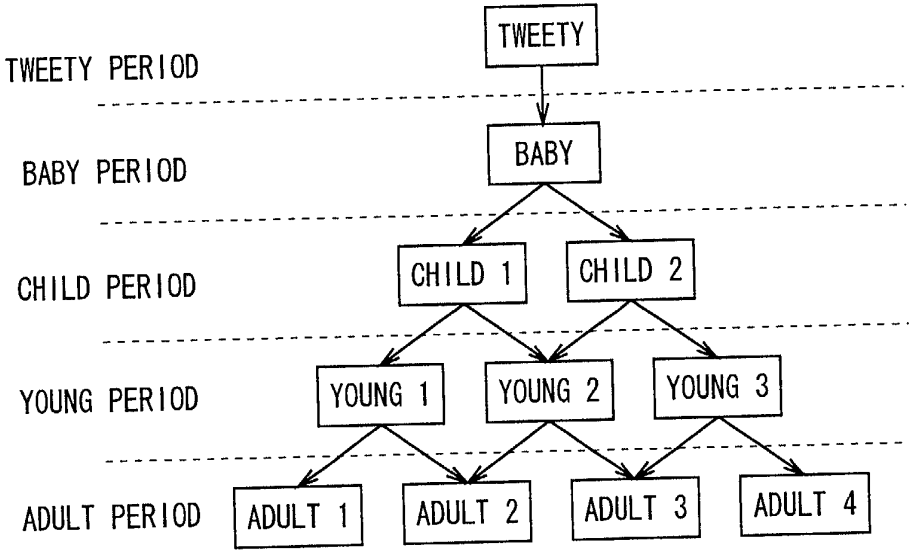


FIG. 10

09/890231

10/24/03, EAST Version: 1.03.0002

FIG. 11

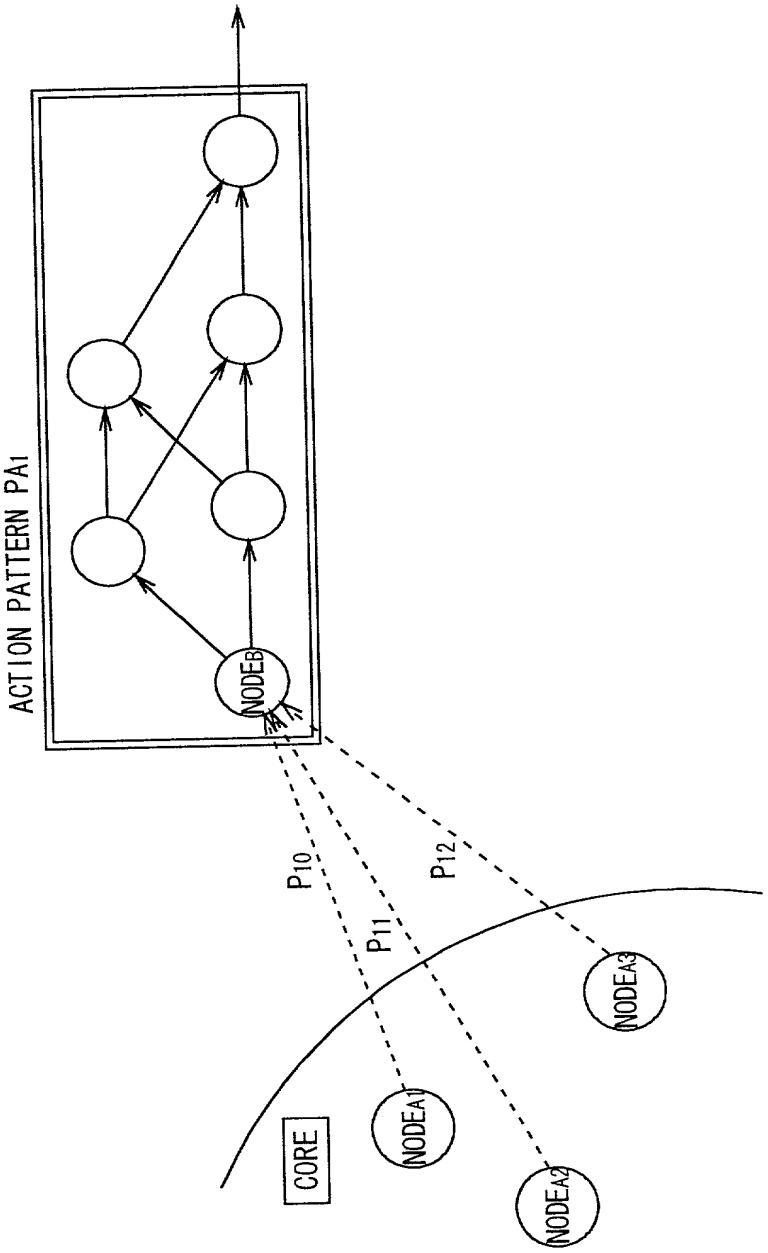

ACTION PATTERN PA1
NODEB
P10
P11
P12
CORE
NODEA1
NODEA2
NODEA3

FIG. 13

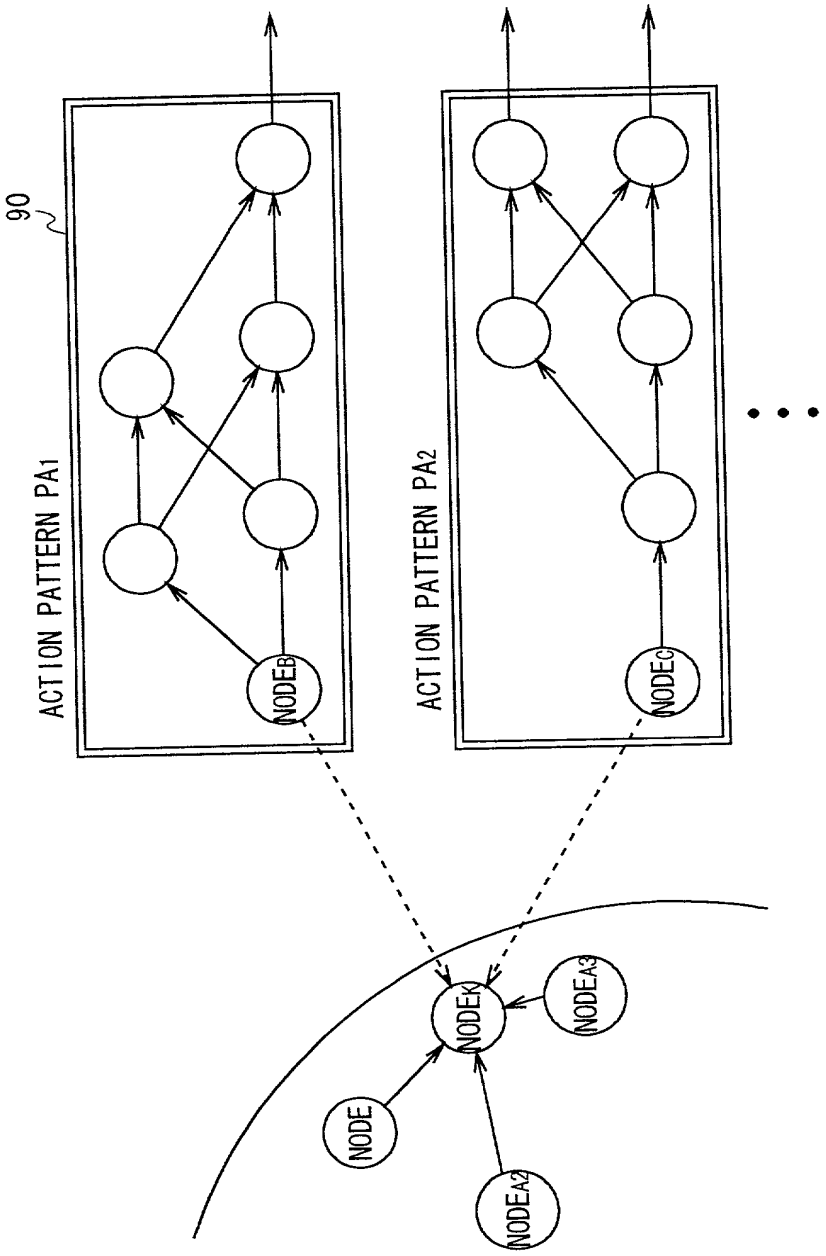

90
ACTION PATTERN PA1
NODEB
ACTION PATTERN PA2
NODEC
NODEK
NODEA3
NODE
NODEA2

FIG. 14

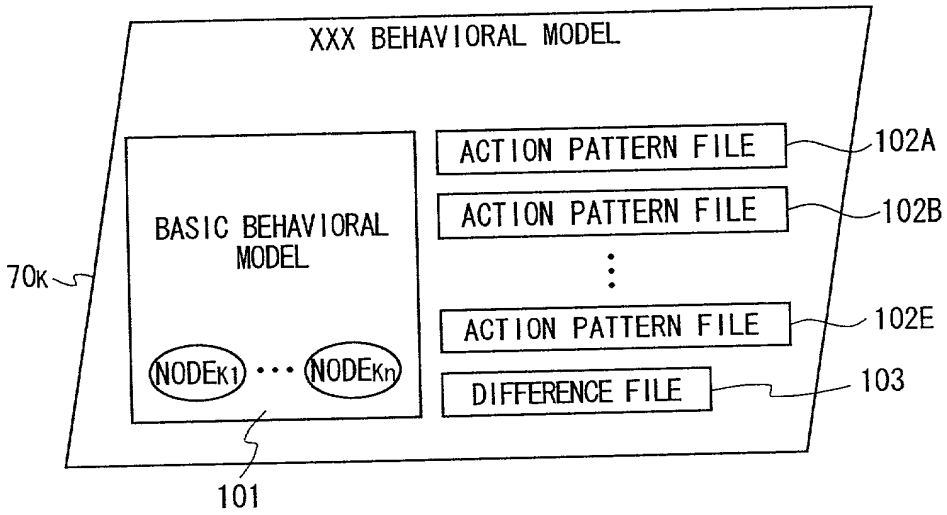

XXX BEHAVIORAL MODEL
BASIC BEHAVIORAL MODEL
NODEK1 ··· NODEKn
70K
101
ACTION PATTERN FILE
102A
ACTION PATTERN FILE
102B
ACTION PATTERN FILE
102E
DIFFERENCE FILE
103

FIG. 15

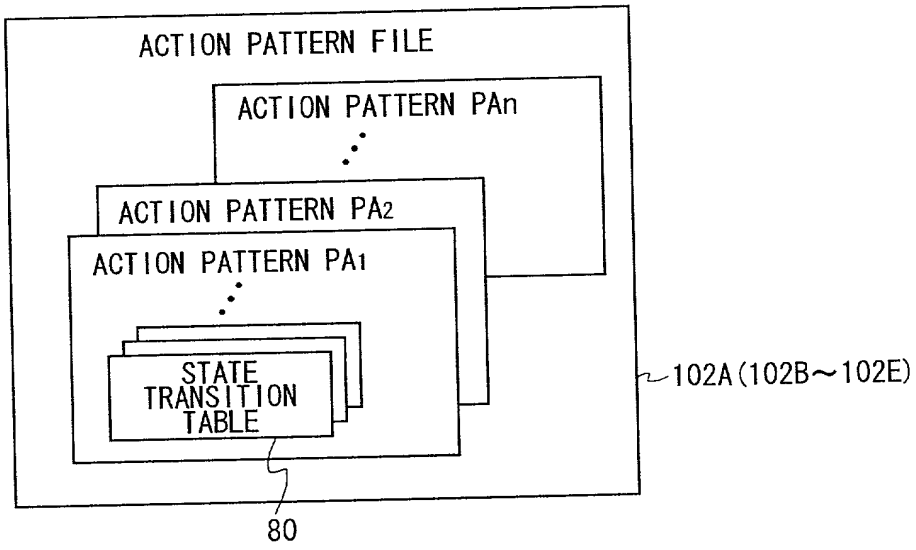

ACTION PATTERN FILE
ACTION PATTERN PAn
ACTION PATTERN PA2
ACTION PATTERN PA1
STATE TRANSITION TABLE
80
102A(102B~102E)

FIG. 16

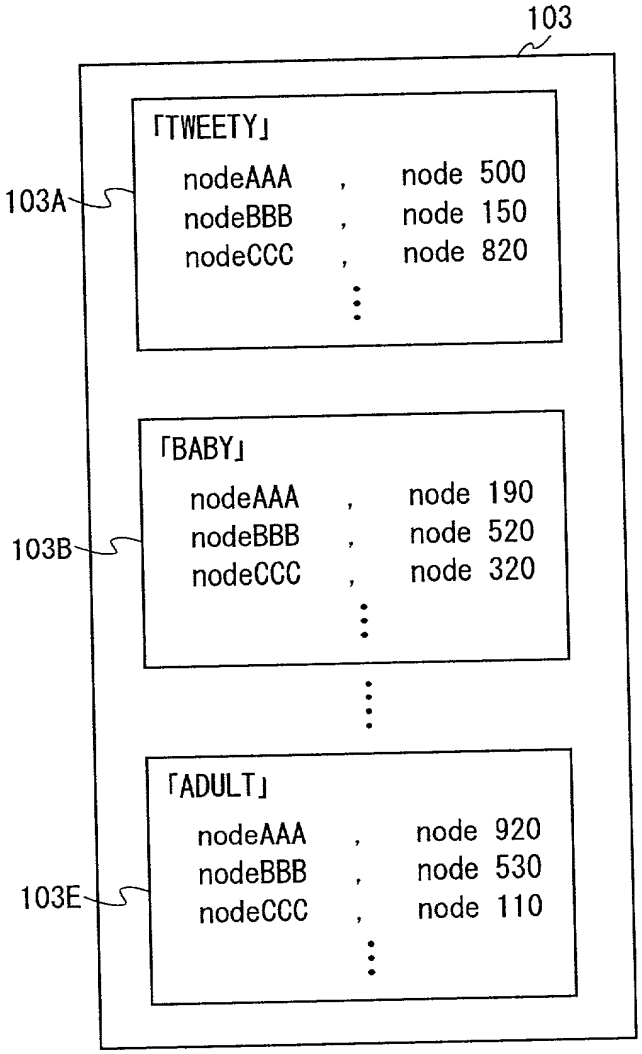
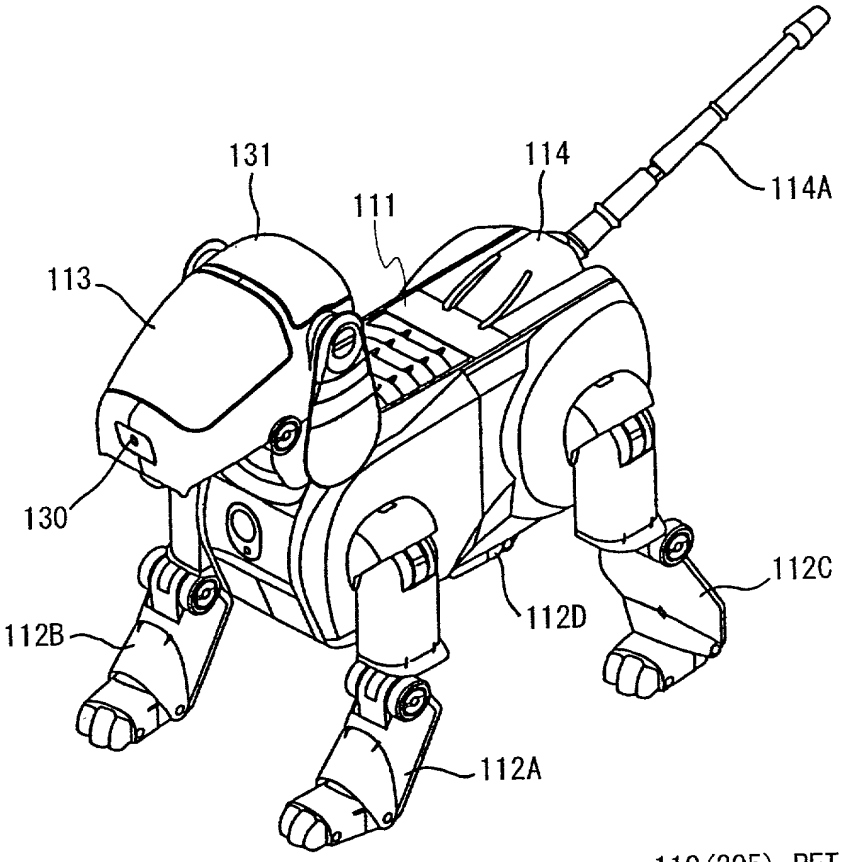

103
「TWEETY」
nodeAAA , node 500
nodeBBB , node 150
nodeCCC , node 820
103A
「BABY」
nodeAAA , node 190
nodeBBB , node 520
nodeCCC , node 320
103B
「ADULT」
nodeAAA , node 920
nodeBBB , node 530
nodeCCC , node 110
103E

FIG. 17



110(205) PET ROBOT

FIG. 18

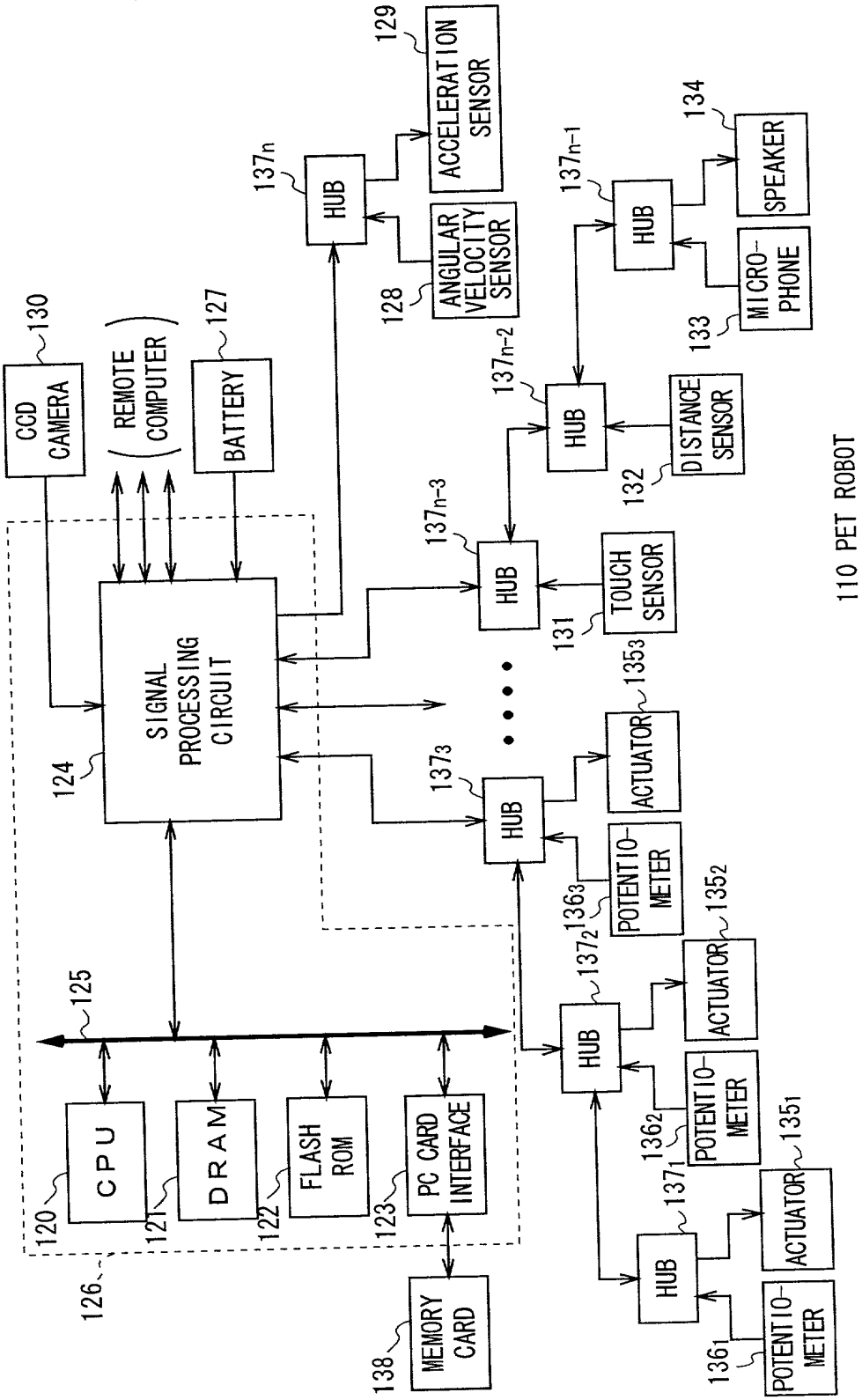

110 PET ROBOT
SIGNAL PROCESSING CIRCUIT
124
CCD CAMERA
130
REMOTE COMPUTER
BATTERY
127
CPU
120
DRAM
121
FLASH ROM
122
PC CARD INTERFACE
123
125
126
MEMORY CARD
138
HUB
137n
ACCELERATION SENSOR
129
ANGULAR VELOCITY SENSOR
128
137n-1
SPEAKER
134
MICRO-PHONE
133
137n-2
DISTANCE SENSOR
132
137n-3
TOUCH SENSOR
131
1373
ACTUATOR
1353
POTENTIO-METER
1363
1372
ACTUATOR
1352
POTENTIO-METER
1362
1371
ACTUATOR
1351
POTENTIO-METER
1361

FIG. 19

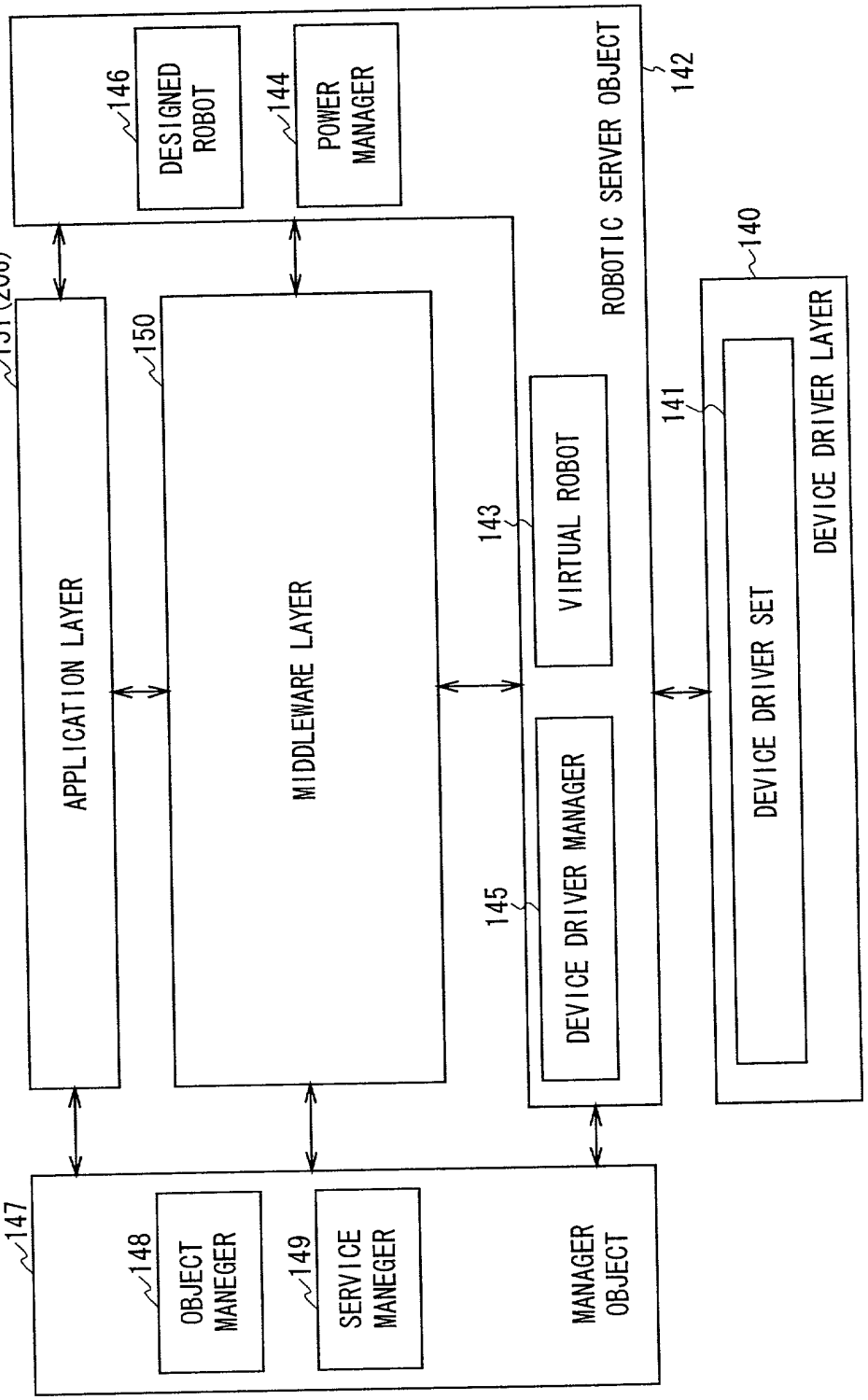

ROBOTIC SERVER OBJECT
142
146
DESIGNED ROBOT
144
POWER MANAGER
151 (206)
APPLICATION LAYER
150
MIDDLEWARE LAYER
143
VIRTUAL ROBOT
145
DEVICE DRIVER MANAGER
141
140
DEVICE DRIVER LAYER
DEVICE DRIVER SET
147
MANAGER OBJECT
148
OBJECT MANEGER
149
SERVICE MANEGER

FIG. 20

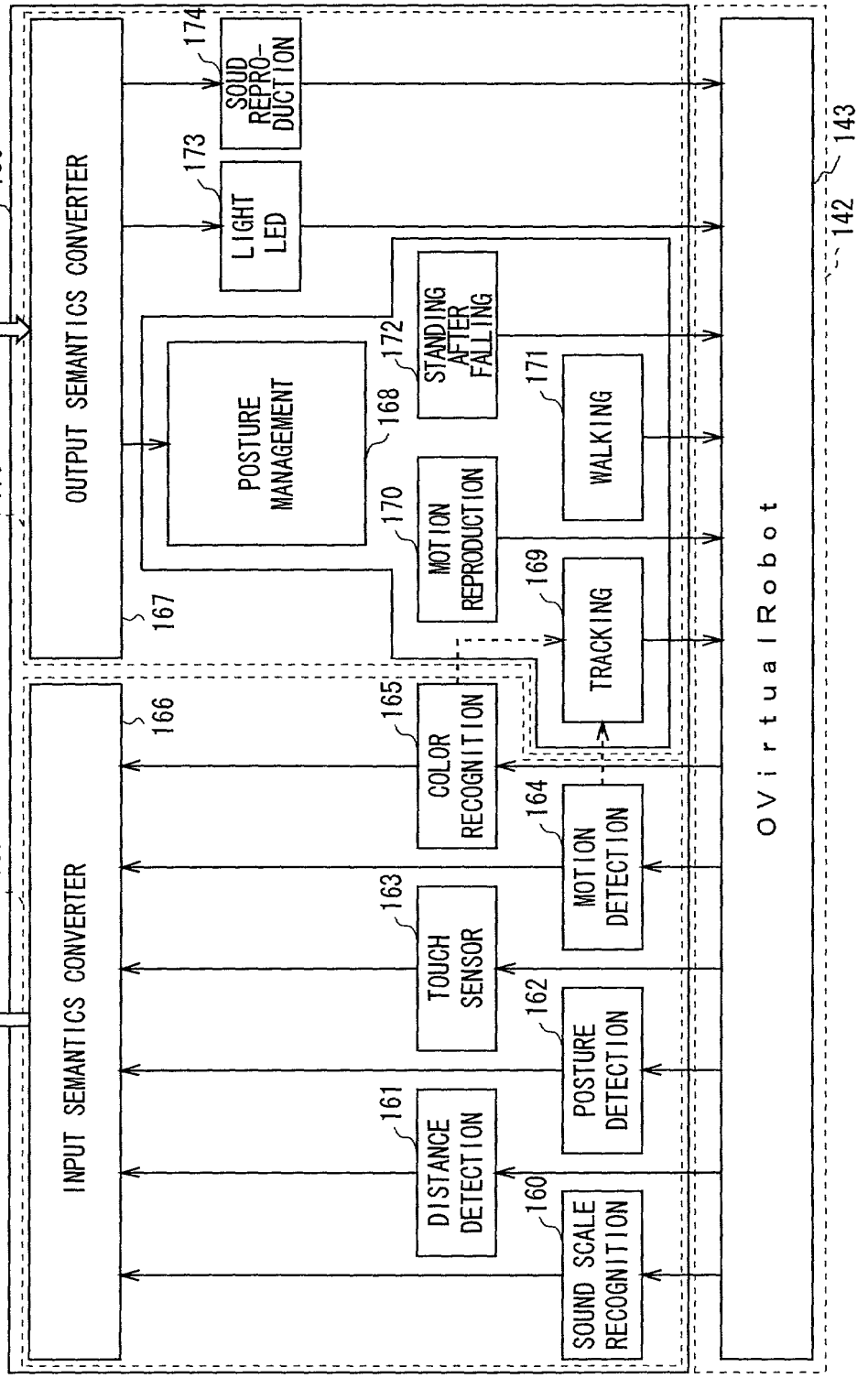

INPUT SEMANTICS CONVERTER
OUTPUT SEMANTICS CONVERTER
VirtualRobot
SOUND SCALE RECOGNITION
DISTANCE DETECTION
POSTURE DETECTION
TOUCH SENSOR
MOTION DETECTION
COLOR RECOGNITION
TRACKING
MOTION REPRODUCTION
POSTURE MANAGEMENT
WALKING
STANDING AFTER FALLING
LIGHT LED
SOUD REPRO-DUCTION
160
161
162
163
164
165
166
167
167
168
169
170
171
172
173
174
175
142
143
150

FIG. 21

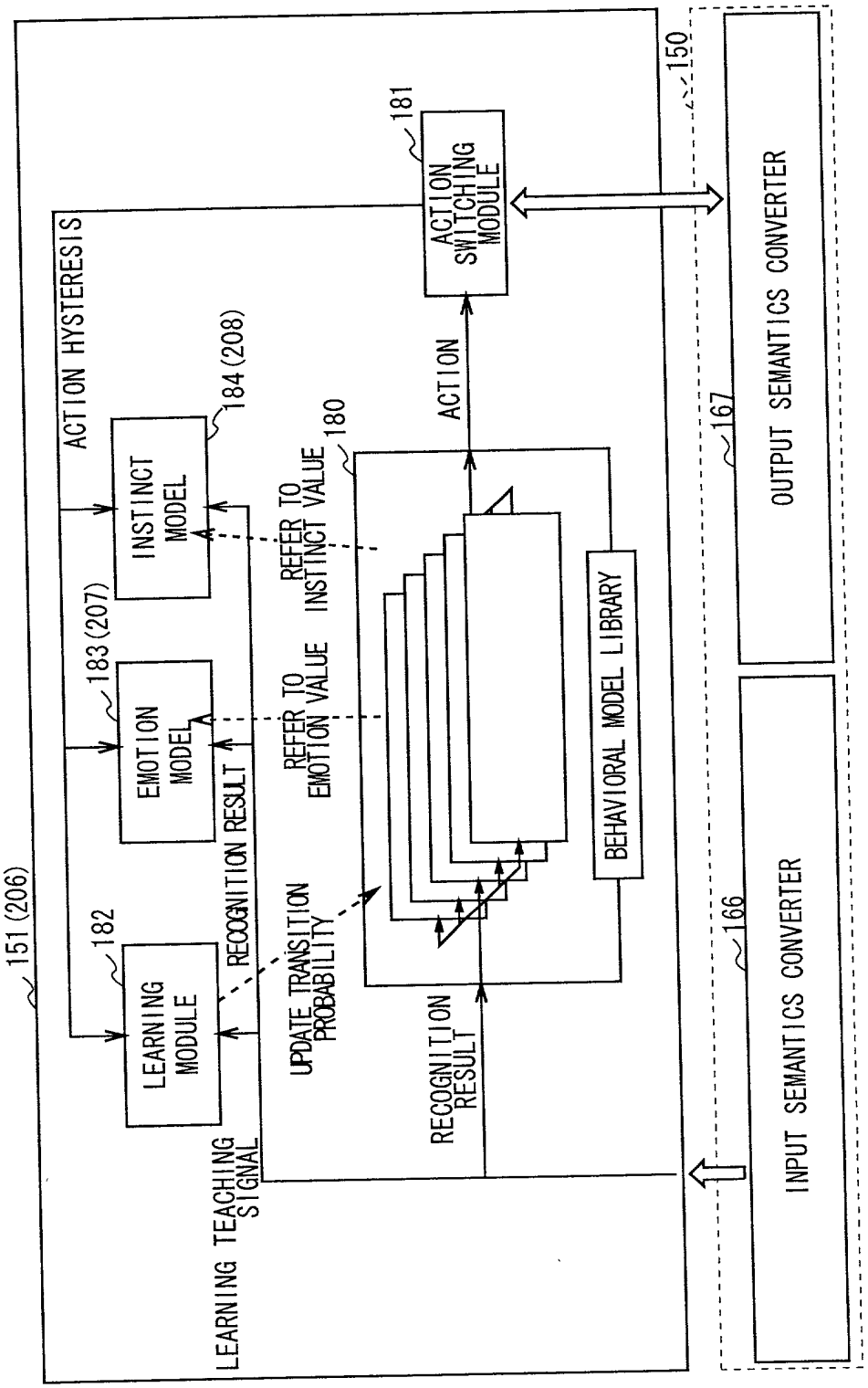

151 (206)
ACTION HYSTERESIS
182
LEARNING MODULE
183 (207)
EMOTION MODEL
184 (208)
INSTINCT MODEL
180
181
ACTION SWITCHING MODULE
150
167
OUTPUT SEMANTICS CONVERTER
166
INPUT SEMANTICS CONVERTER
BEHAVIORAL MODEL LIBRARY
LEARNING TEACHING SIGNAL
RECOGNITION RESULT
UPDATE TRANSITION PROBABILITY
REFER TO EMOTION VALUE
REFER TO INSTINCT VALUE
ACTION
RECOGNITION RESULT

FIG. 22

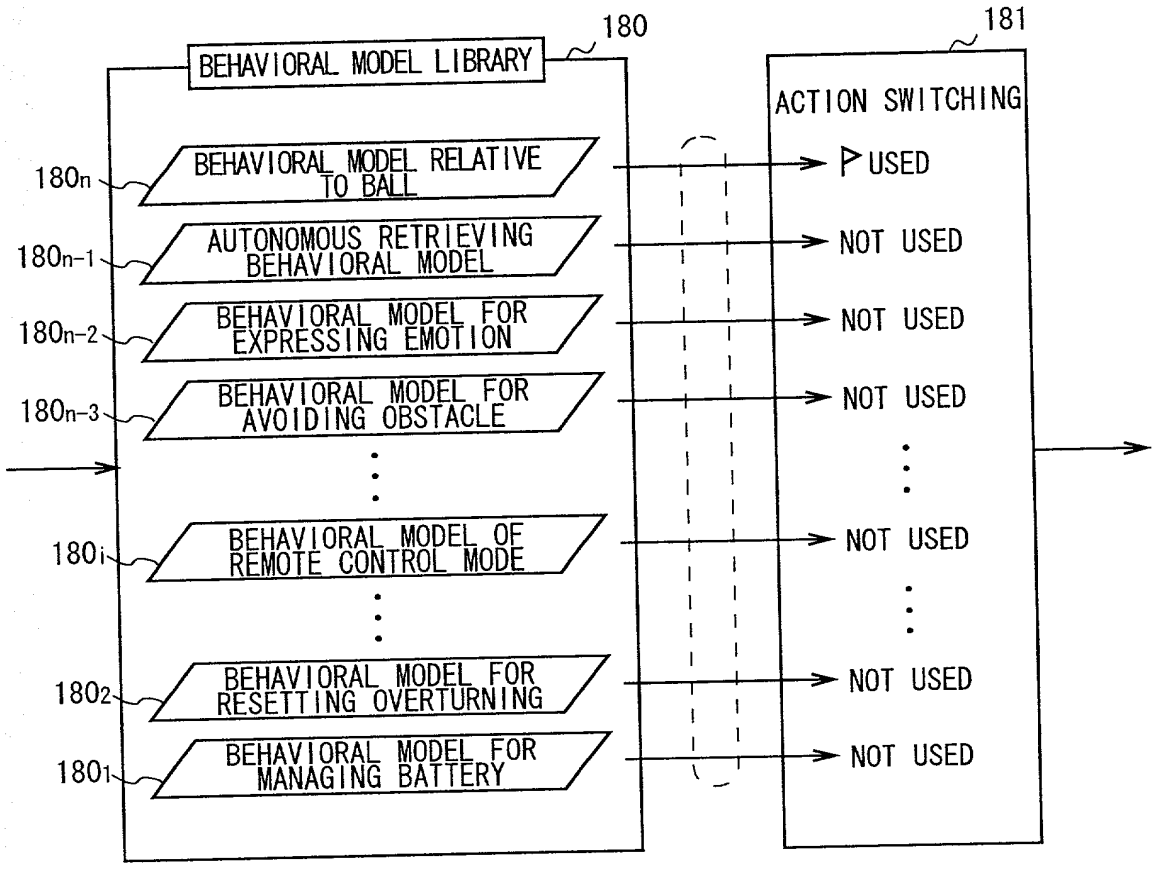

180
BEHAVIORAL MODEL LIBRARY
181
ACTION SWITCHING
180n
BEHAVIORAL MODEL RELATIVE TO BALL
USED
180n-1
AUTONOMOUS RETRIEVING BEHAVIORAL MODEL
NOT USED
180n-2
BEHAVIORAL MODEL FOR EXPRESSING EMOTION
NOT USED
180n-3
BEHAVIORAL MODEL FOR AVOIDING OBSTACLE
NOT USED
180i
BEHAVIORAL MODEL OF REMOTE CONTROL MODE
NOT USED
1802
BEHAVIORAL MODEL FOR RESETTING OVERTURNING
NOT USED
1801
BEHAVIORAL MODEL FOR MANAGING BATTERY
NOT USED

FIG. 23

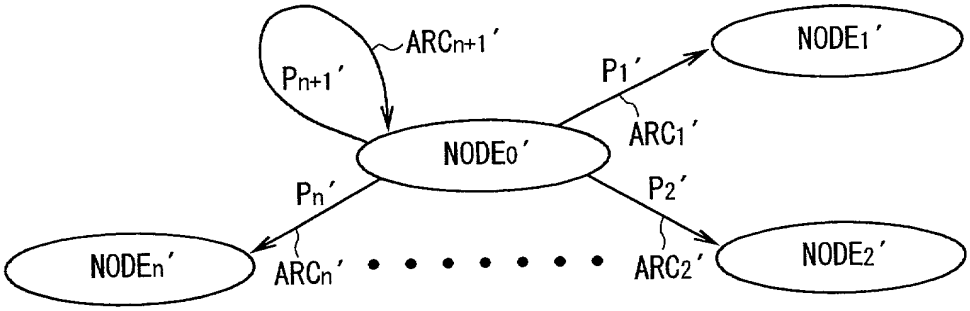


FIG. 24

09890231 022704 JC20 PCT/PTO 26 JUL 2001

T0220 "TE206860

	INPUT EVENT NAME	DATA NAME	RANGE OF DATA	TRANSITION PROBABILITY TO ANOTHER NODE Di				
	node 100			A	B	C	D	n
TRANSITION TARGET NODE				node 120	node120	node 1000		node 600
OUTPUT ACTION				ACTION 1	ACTION 2	MOVE BACK		ACTION 4
1	BALL	SIZE	0.1000	30%				
2	PAT				40%			
3	HIT				20%			
4	MOTION					50%		
5	OBSTACLE	DISTANCE	0.100			100%		
6		JOY	50.100					
7		SUPRISE	50.100					
8		SADNESS	50.100					

190

FIG. 25

09/890231

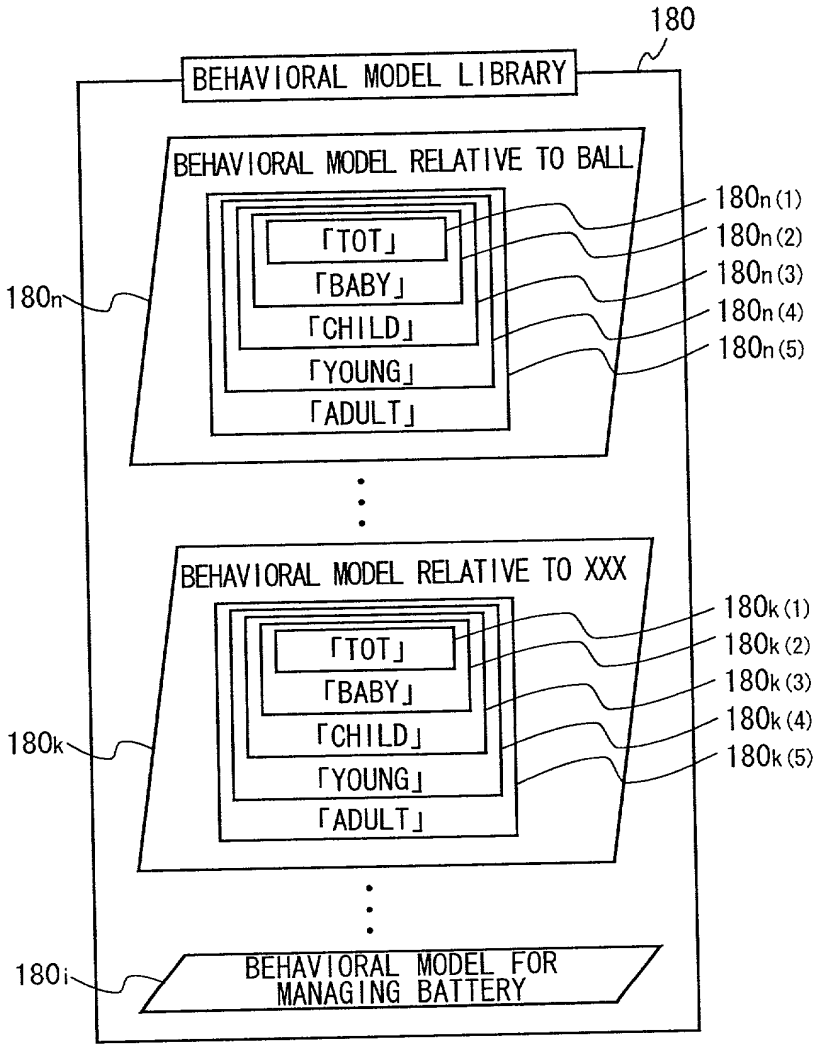

180
BEHAVIORAL MODEL LIBRARY
BEHAVIORAL MODEL RELATIVE TO BALL
「TOT」
「BABY」
「CHILD」
「YOUNG」
「ADULT」
180n
180n(1)
180n(2)
180n(3)
180n(4)
180n(5)
BEHAVIORAL MODEL RELATIVE TO XXX
「TOT」
「BABY」
「CHILD」
「YOUNG」
「ADULT」
180k
180k(1)
180k(2)
180k(3)
180k(4)
180k(5)
180i
BEHAVIORAL MODEL FOR MANAGING BATTERY

FIG. 26

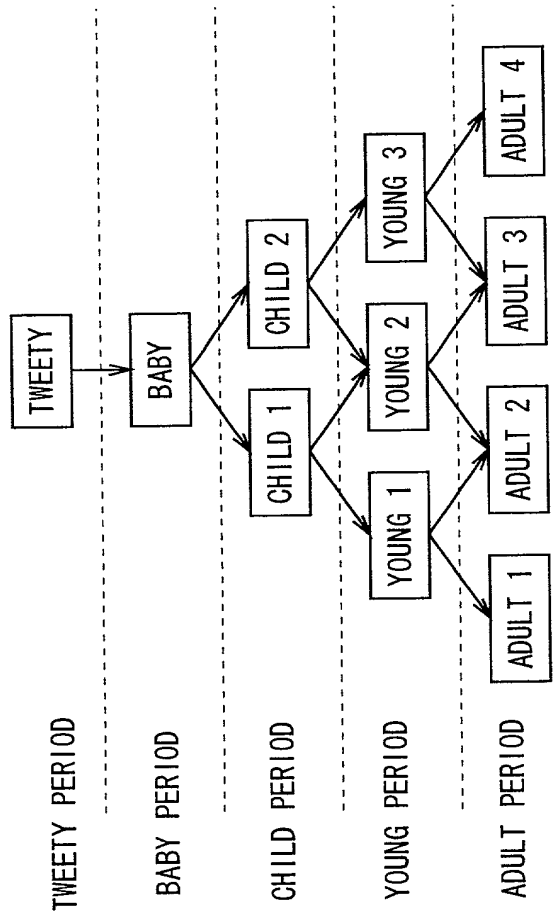

TWEETY
BABY
CHILD 1
CHILD 2
YOUNG 1
YOUNG 2
YOUNG 3
ADULT 1
ADULT 2
ADULT 3
ADULT 4
TWEETY PERIOD
BABY PERIOD
CHILD PERIOD
YOUNG PERIOD
ADULT PERIOD

FIG. 27

TD2820 TE206860

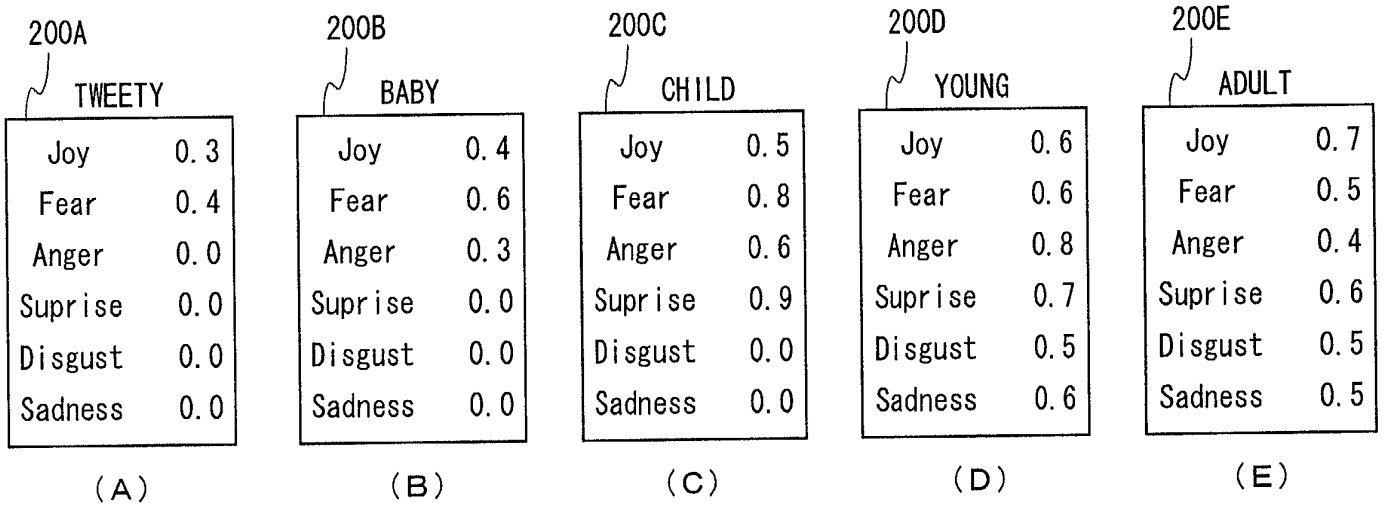


FIG. 28

09/890231

TWEETY PERIOD
BABY PERIOD
CHILD PERIOD
YOUNG PERIOD
ADULT PERIOD
Joy, Fear
Joy, Fear, Anger
Joy, Fear, Anger, Surprise
Joy, Sadness, Fear, Anger, disgust, Surprise
Joy, Sadness, Fear, Anger, disgust, surprise
(A)
Appetite
Appetite Affection
Appetite Affection curiosity
Exercise Appetite Affection curiosity
Exercise Appetite Affection curiosity
(B)

FIG. 29

TD2320 TE206860

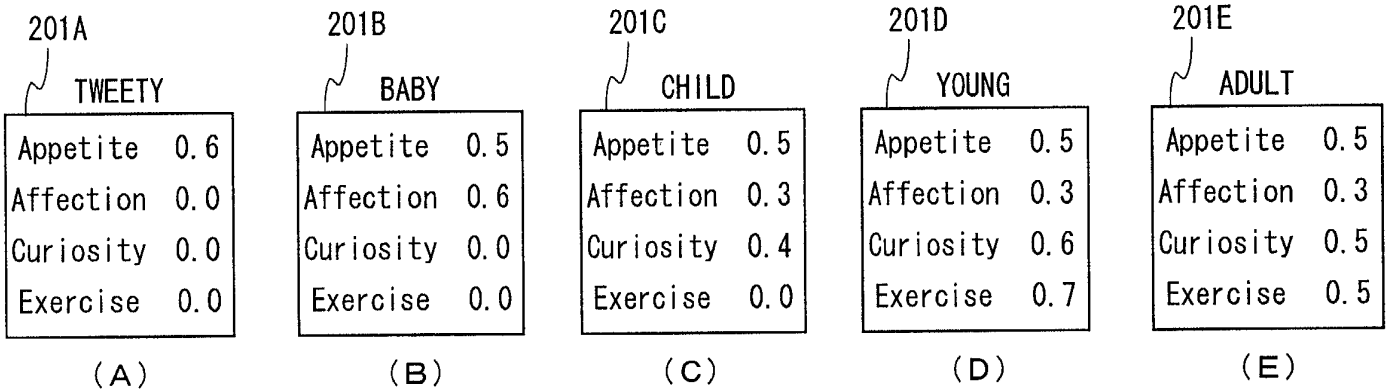


FIG. 30

09/890231

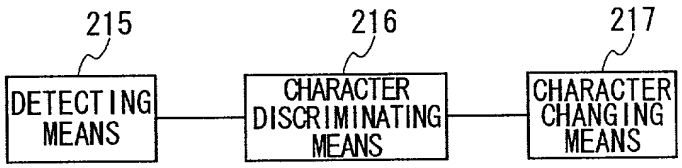


FIG. 31

09/890231 PCT/JP00/00231 09.08.2001

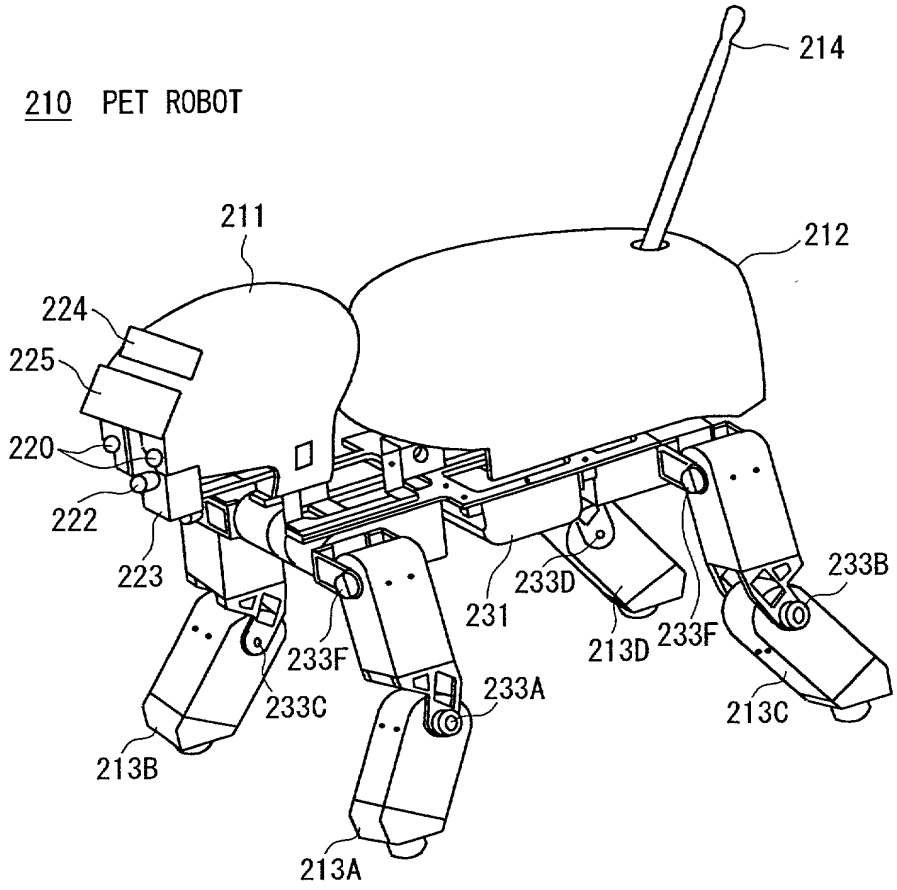


FIG. 32

JP02.20.PE20360

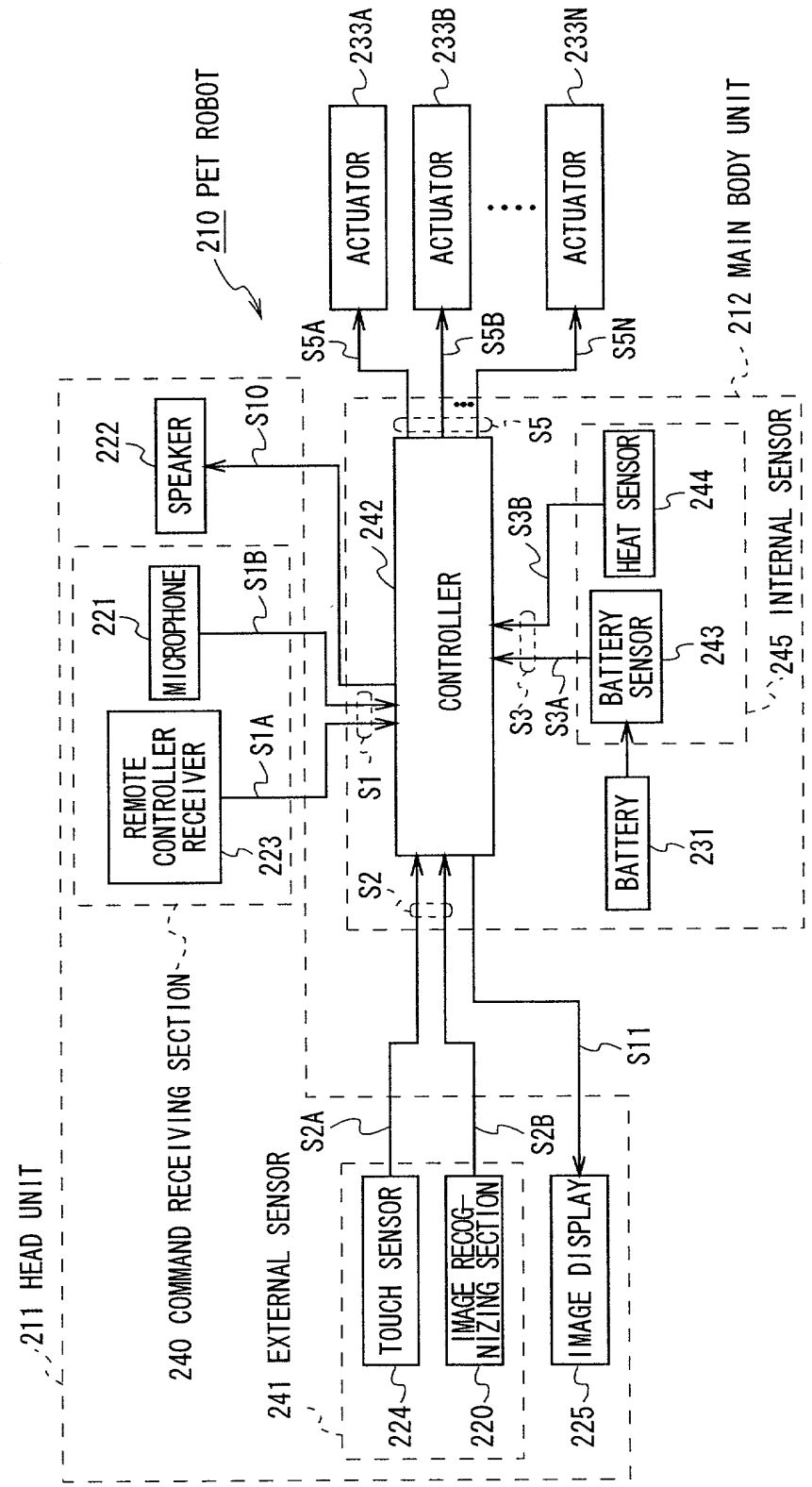

210 PET ROBOT
211 HEAD UNIT
240 COMMAND RECEIVING SECTION
241 EXTERNAL SENSOR
212 MAIN BODY UNIT
245 INTERNAL SENSOR
ACTUATOR
ACTUATOR
ACTUATOR
233A
233B
233N
S5A
S5B
S5N
S5
SPEAKER
222
S10
MICROPHONE
221
S1B
REMOTE CONTROLLER RECEIVER
223
S1A
S1
CONTROLLER
242
S2
S3B
S3
S3A
HEAT SENSOR
244
BATTERY SENSOR
243
BATTERY
231
TOUCH SENSOR
224
IMAGE RECOGNIZING SECTION
220
IMAGE DISPLAY
225
S2A
S2B
S11

FIG. 33

JP02/2016860

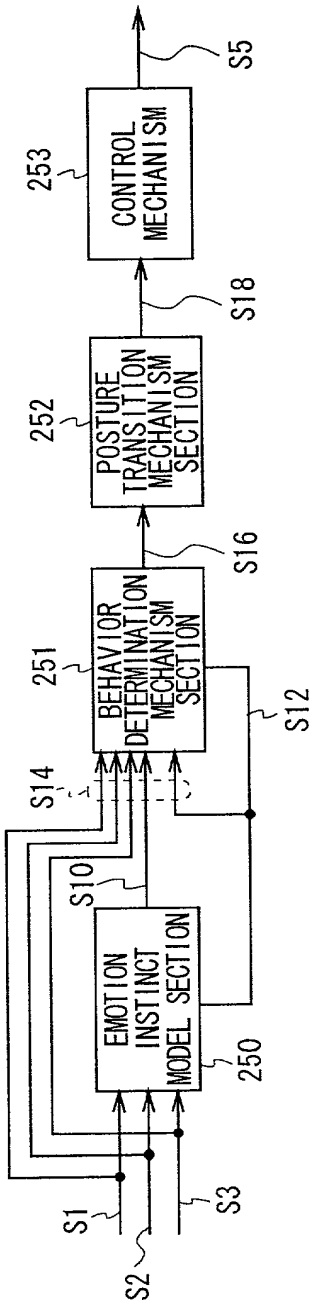


FIG. 34

T04240 TE206860

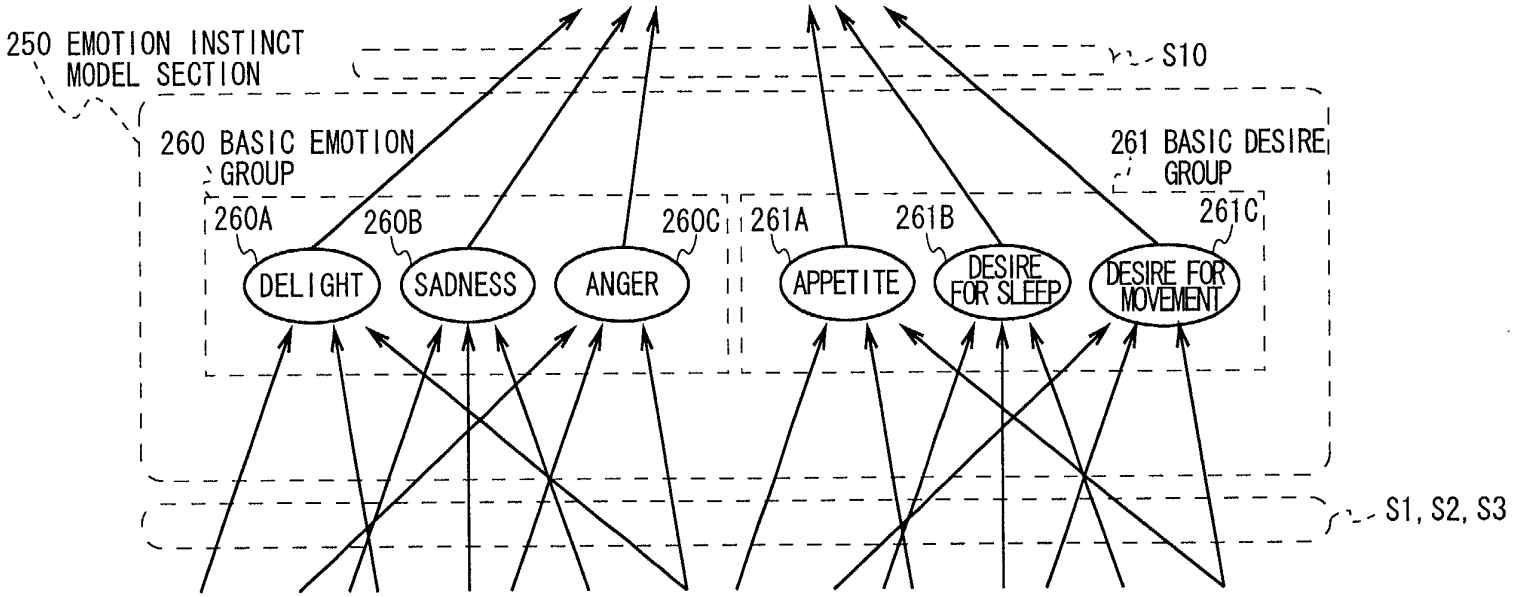


FIG. 35

09/890231

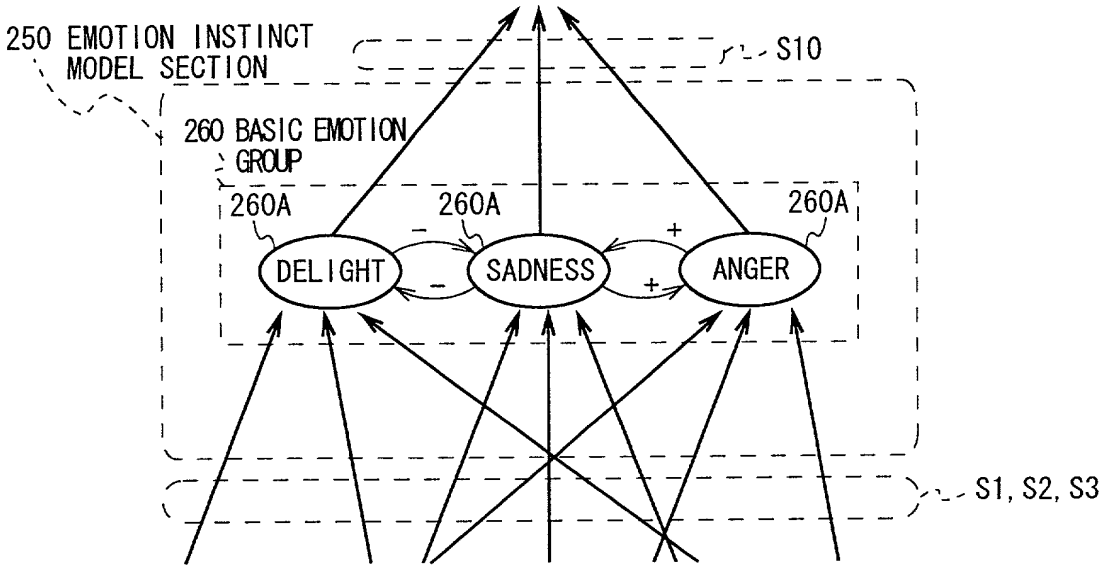

250 EMOTION INSTINCT MODEL SECTION
S10
260 BASIC EMOTION GROUP
260A
260A
260A
DELIGHT
SADNESS
ANGER
S1, S2, S3

FIG. 36

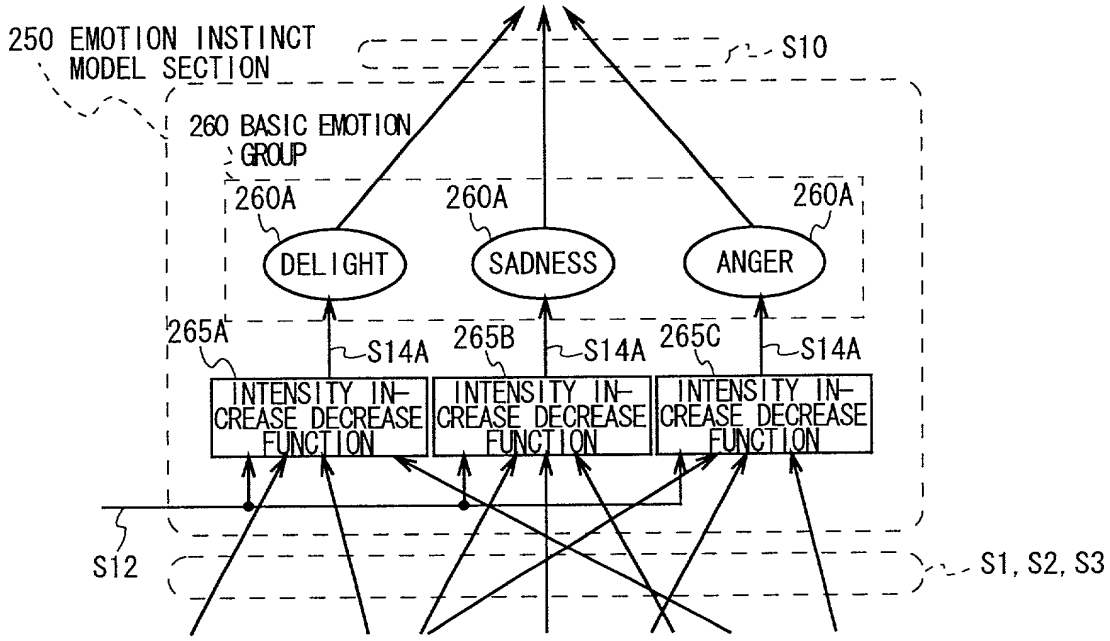

250 EMOTION INSTINCT MODEL SECTION
S10
260 BASIC EMOTION GROUP
260A
260A
260A
DELIGHT
SADNESS
ANGER
265A
S14A
265B
S14A
265C
S14A
INTENSITY INCREASE DECREASE FUNCTION
INTENSITY INCREASE DECREASE FUNCTION
INTENSITY INCREASE DECREASE FUNCTION
S12
S1, S2, S3

FIG. 37

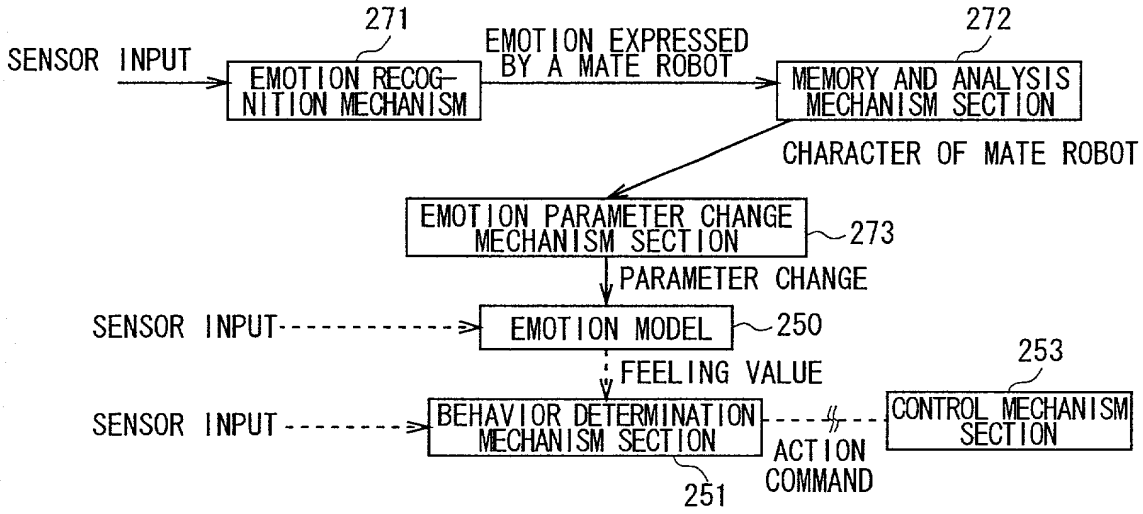

271
SENSOR INPUT
EMOTION RECOG-
NITION MECHANISM
EMOTION EXPRESSED
BY A MATE ROBOT
272
MEMORY AND ANALYSIS
MECHANISM SECTION
CHARACTER OF MATE ROBOT
EMOTION PARAMETER CHANGE
MECHANISM SECTION
273
PARAMETER CHANGE
SENSOR INPUT
EMOTION MODEL
250
FEELING VALUE
253
SENSOR INPUT
BEHAVIOR DETERMINATION
MECHANISM SECTION
CONTROL MECHANISM
SECTION
ACTION
COMMAND
251

FIG. 38

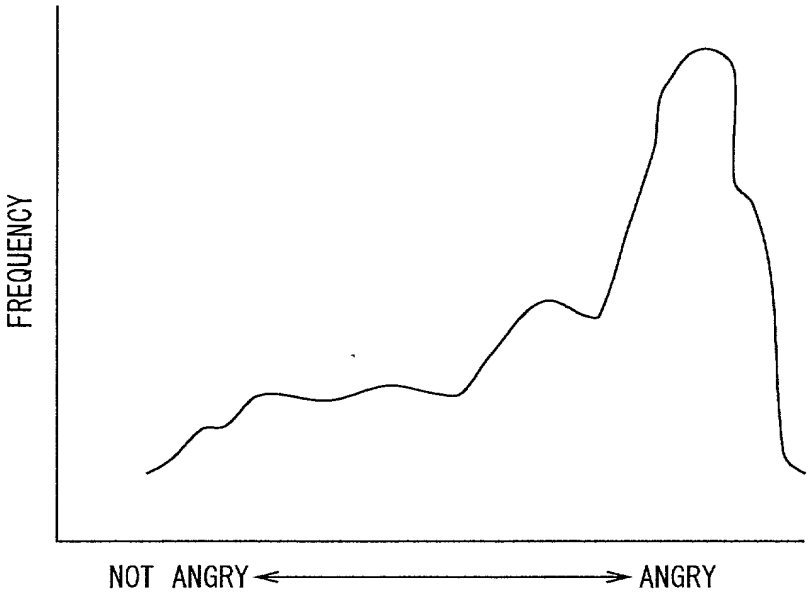

FREQUENCY
NOT ANGRY
ANGRY

FIG. 39

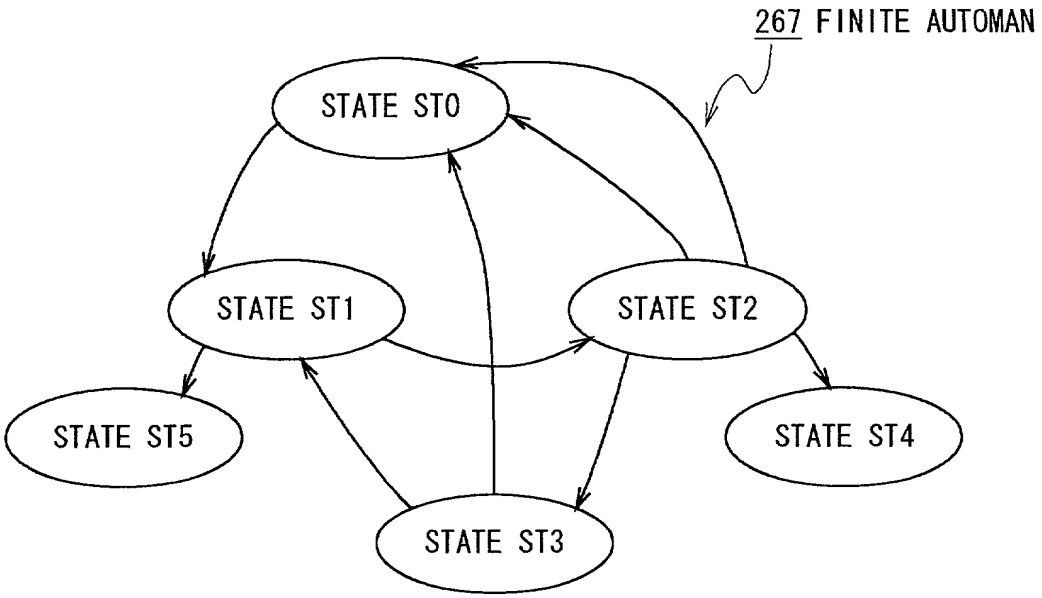


FIG. 40

JP02-07-15:20:36:60

270 DIRECTED GRAPH

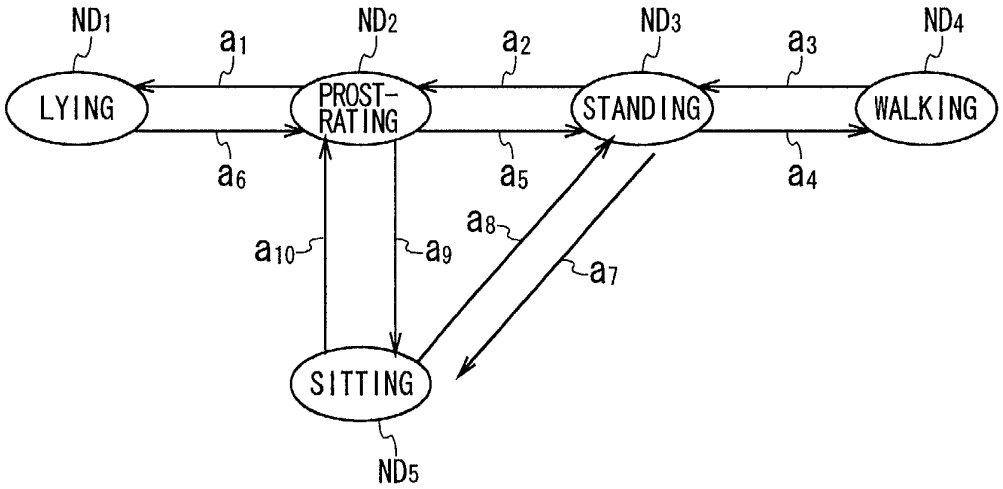


FIG. 41

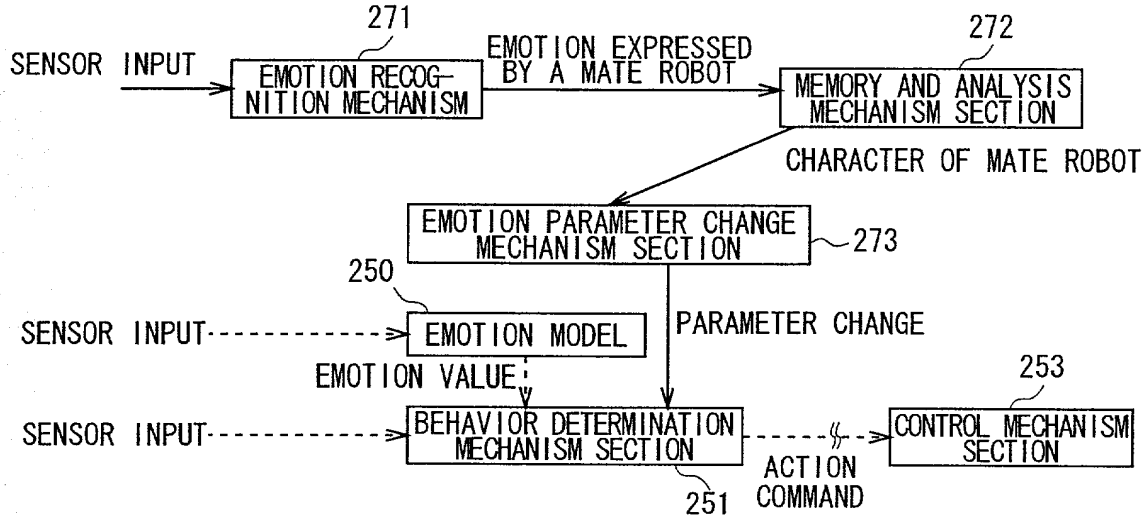

271
SENSOR INPUT
EMOTION RECOG-NITION MECHANISM
EMOTION EXPRESSED BY A MATE ROBOT
272
MEMORY AND ANALYSIS MECHANISM SECTION
CHARACTER OF MATE ROBOT
EMOTION PARAMETER CHANGE MECHANISM SECTION
273
250
SENSOR INPUT
EMOTION MODEL
PARAMETER CHANGE
EMOTION VALUE
253
SENSOR INPUT
BEHAVIOR DETERMINATION MECHANISM SECTION
CONTROL MECHANISM SECTION
ACTION COMMAND
251

FIG. 42

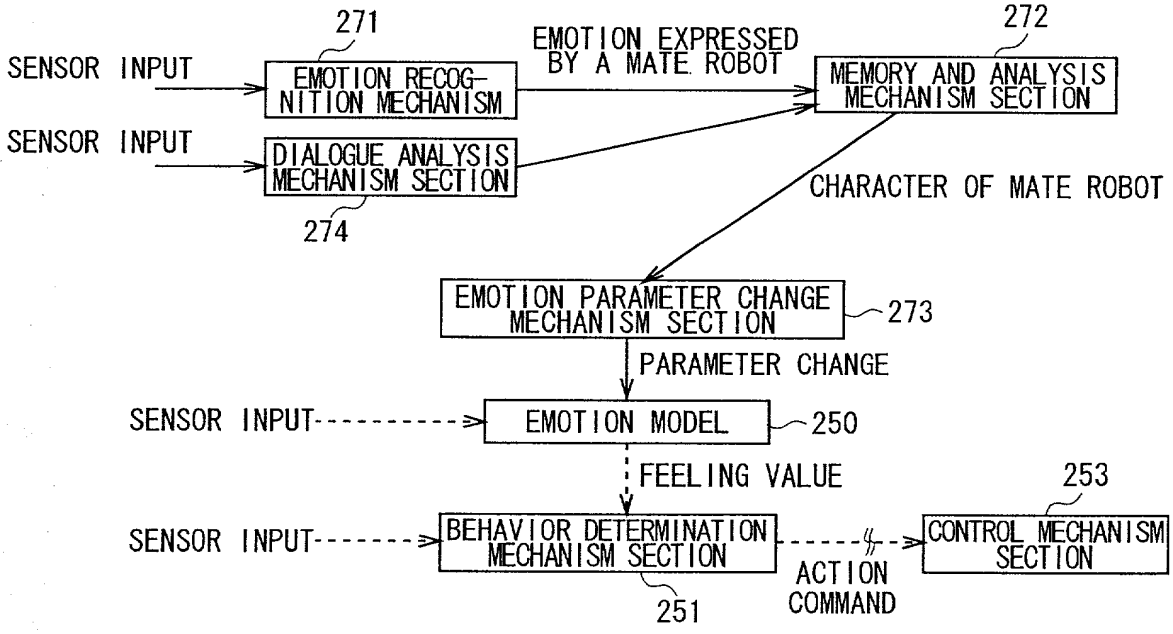
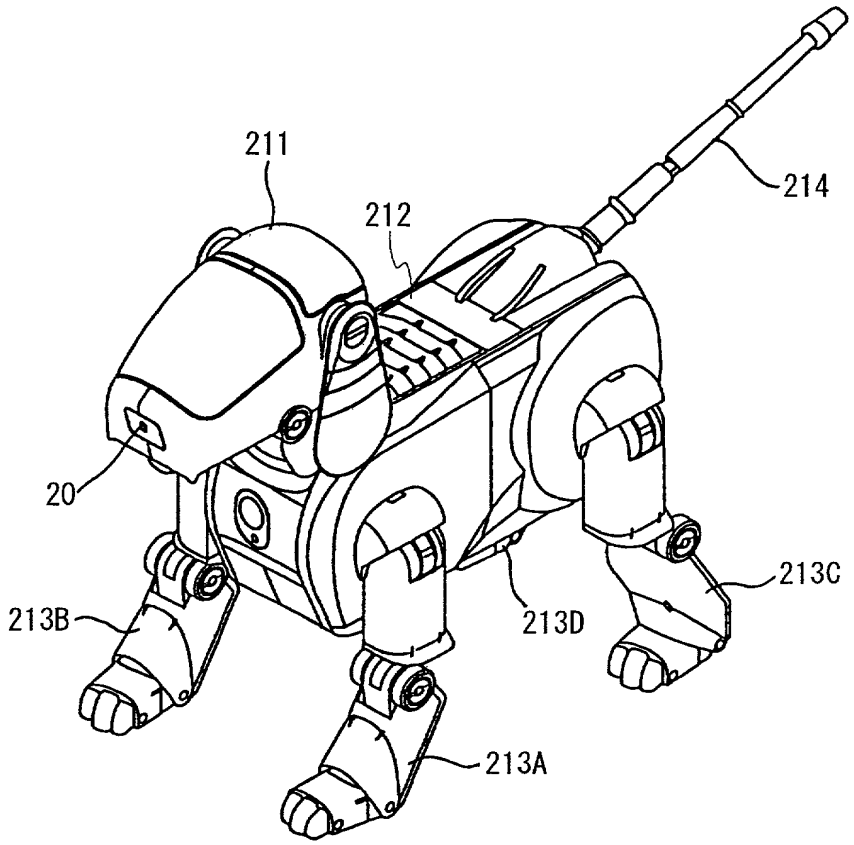

271
SENSOR INPUT
EMOTION RECOG-NITION MECHANISM
EMOTION EXPRESSED BY A MATE ROBOT
272
MEMORY AND ANALYSIS MECHANISM SECTION
SENSOR INPUT
DIALOGUE ANALYSIS MECHANISM SECTION
274
CHARACTER OF MATE ROBOT
EMOTION PARAMETER CHANGE MECHANISM SECTION
273
PARAMETER CHANGE
SENSOR INPUT
EMOTION MODEL
250
FEELING VALUE
253
SENSOR INPUT
BEHAVIOR DETERMINATION MECHANISM SECTION
CONTROL MECHANISM SECTION
ACTION COMMAND
251

FIG. 43



210 PET ROBOT

FIG. 44

Explanation of Reference Numerals

1, 100, 110, 205, 210...pet robot, 10, 120, 242...CPU, 16, 126...control unit, 33, 143...virtual robot, 40, 150...middleware layer, 41, 151, 206...application layer, 70, 180...behavioral model library, 70_1 to 70_n, 70_k, $70_{k(1)}$ to $70_{k(5)}$, 180_1 to 180_n, 180_k, $180_{k(1)}$ to $180_{k(5)}$, $180_{n(1)}$ to $180_{n(5)}$ ...behavioral model, 91A to 91D, 103...difference file, 101...basic behavioral model, 102A to 102E...action pattern file, PA_1 to PA_n...action pattern, $NODE_{K1}$ to $NODE_{Kn}$...virtual node, 200A to 200E...emotion parameter file, 201A to 201E...instinct parameter file, 72, 182...learning module, 73, 102, 183, 207...emotion model, 74, 103, 184, 208...instinct model, k_e to k_i...coefficient, 215...detecting means, 216...character discriminating means, 217...character changing means, 270...emotion recognition mechanism section, 271...memory and analysis mechanism section, 273...emotion parameter change mechanism section, 274...dialogue analysis mechanism section.